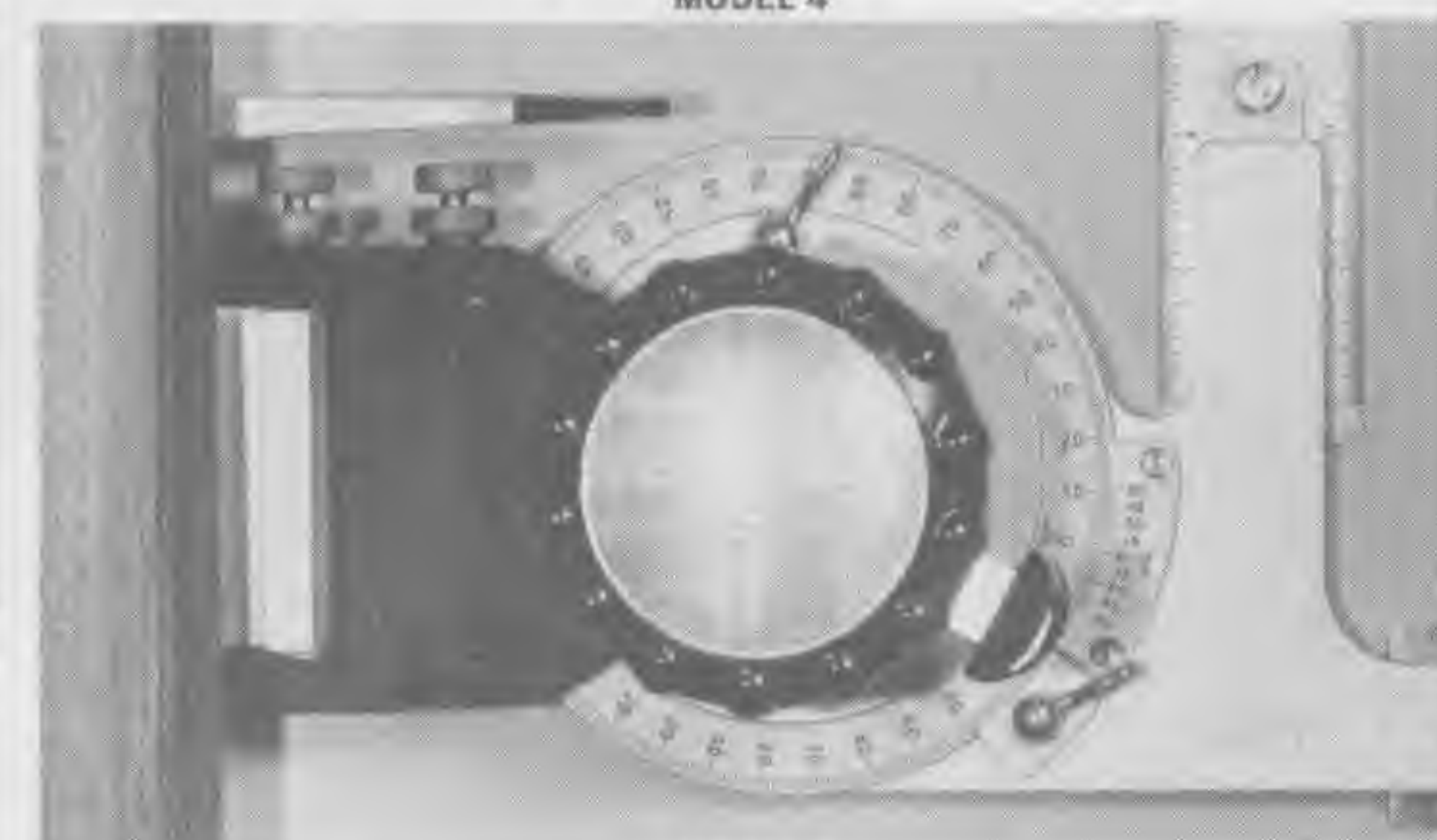




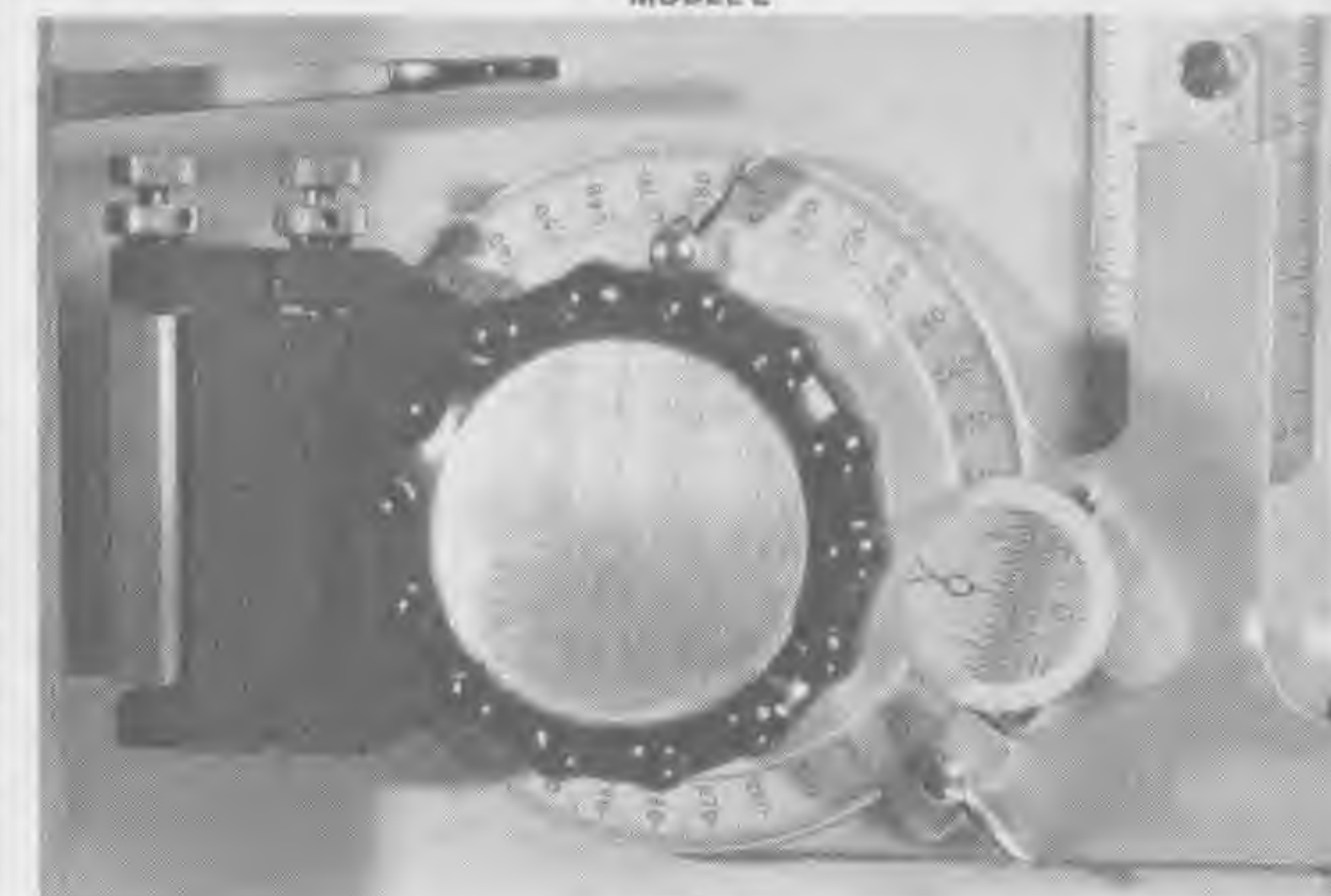
V-TRACK DRAFTING MACHINE USER'S MANUAL



MODEL 4



MODEL 2



MODEL 3

UMT-0576

Instructions for installing and maintaining
all VEMCO V-TRACK[®] Drafting Machines

INTRODUCTION

Track-type drafting machines achieve parallel motion of a protractor head and scales by means of two carriages moving in a pair of mutually perpendicular tracks. All VEMCO V-TRACK machines have essentially the same tracking system, the only variables being the length of the tracks and the finish. There is, however, a selection of three protractor heads, and this booklet describes the operation and adjustment of all of these. The Model 2 head has all of the features one expects to find in a high-quality drafting machine — convenient 15-degree indexing, 360-degree baseline adjustment, 5-minute vernier, etc. The Model 3, or Civil Engineer's head, has a 1-minute vernier and a micrometer adjusting screw for increased accuracy, but it lacks

the indexing mechanism. The Model 4 head has all of the features of the Model 2, but, in addition, it is equipped with a micrometer base-line adjusting screw, a returnable base-line feature, and has a centrally located indexing control button for maximum convenience.

Unless he is already familiar with the operation of VEMCO V-TRACK drafting machines, the user should read the sections of this booklet entitled "PREPARATION FOR USE" and "OPERATION." The sections on "ADJUSTMENTS" and "MAINTENANCE AND REPAIRS" deal with situations that, if the machine is treated with reasonable care, will arise very infrequently.

WARRANTY

Vemco Drafting Machines Are Guaranteed Unconditionally against defects in material or workmanship for a period of twenty-four months after receipt by the original user. When returned to the factory, the machine will be repaired without charge. Freight charges to the factory are to be paid by the customer with return freight charges to the customer to be paid by VEMCO.

This warranty does not cover damages from such causes as abuse, accident, neglect or fire.

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PREPARATION FOR USE

Installation

Your VEMCO V-TRACK drafting machine consists of three major assemblies: the horizontal track, the vertical track and the protractor head. The vertical track has been "squared" with its corresponding horizontal track and should not be used with any other. The serial number has been stamped on both the vertical and the horizontal carriages for identification. The following steps are recommended for installation.

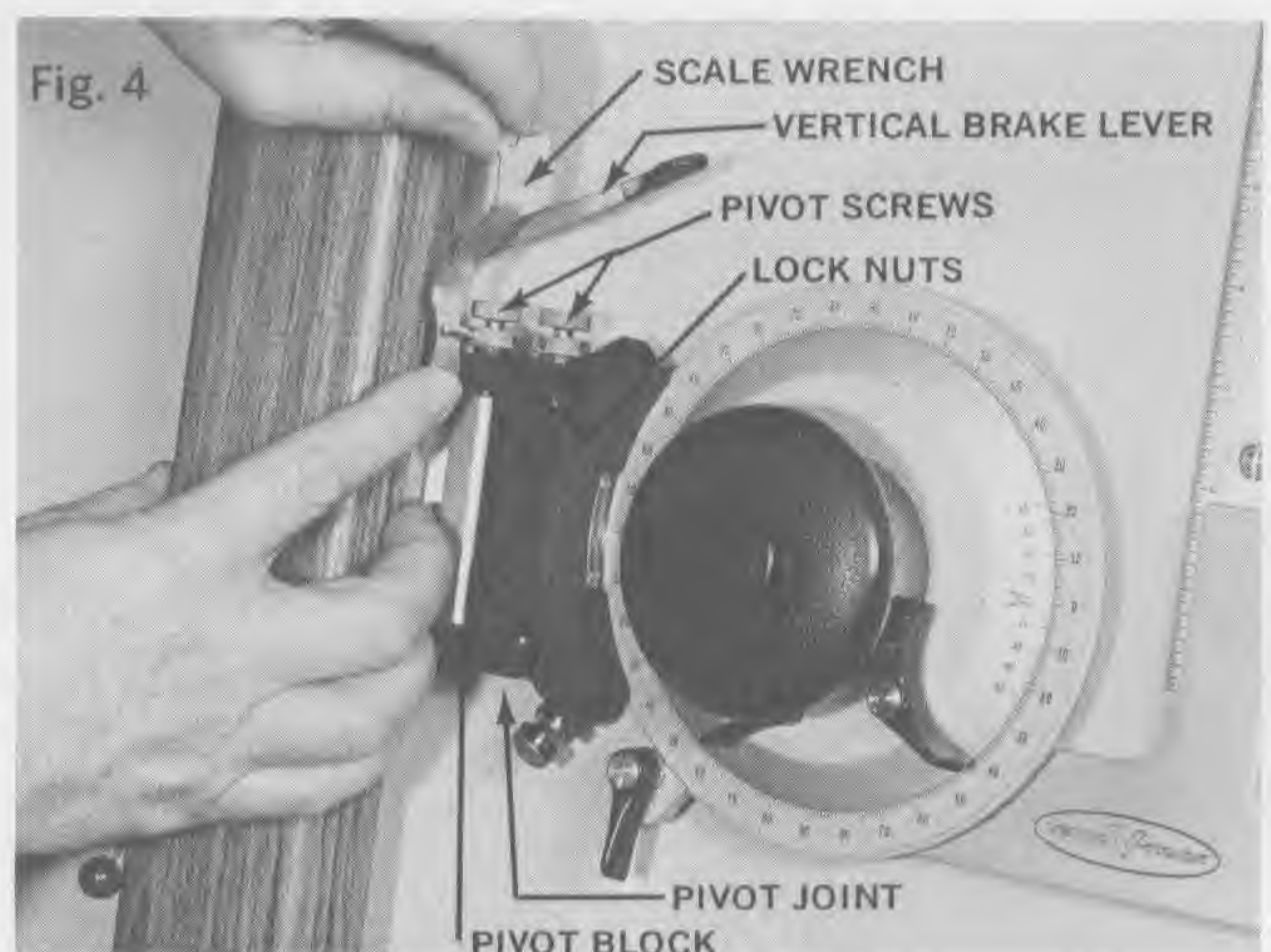
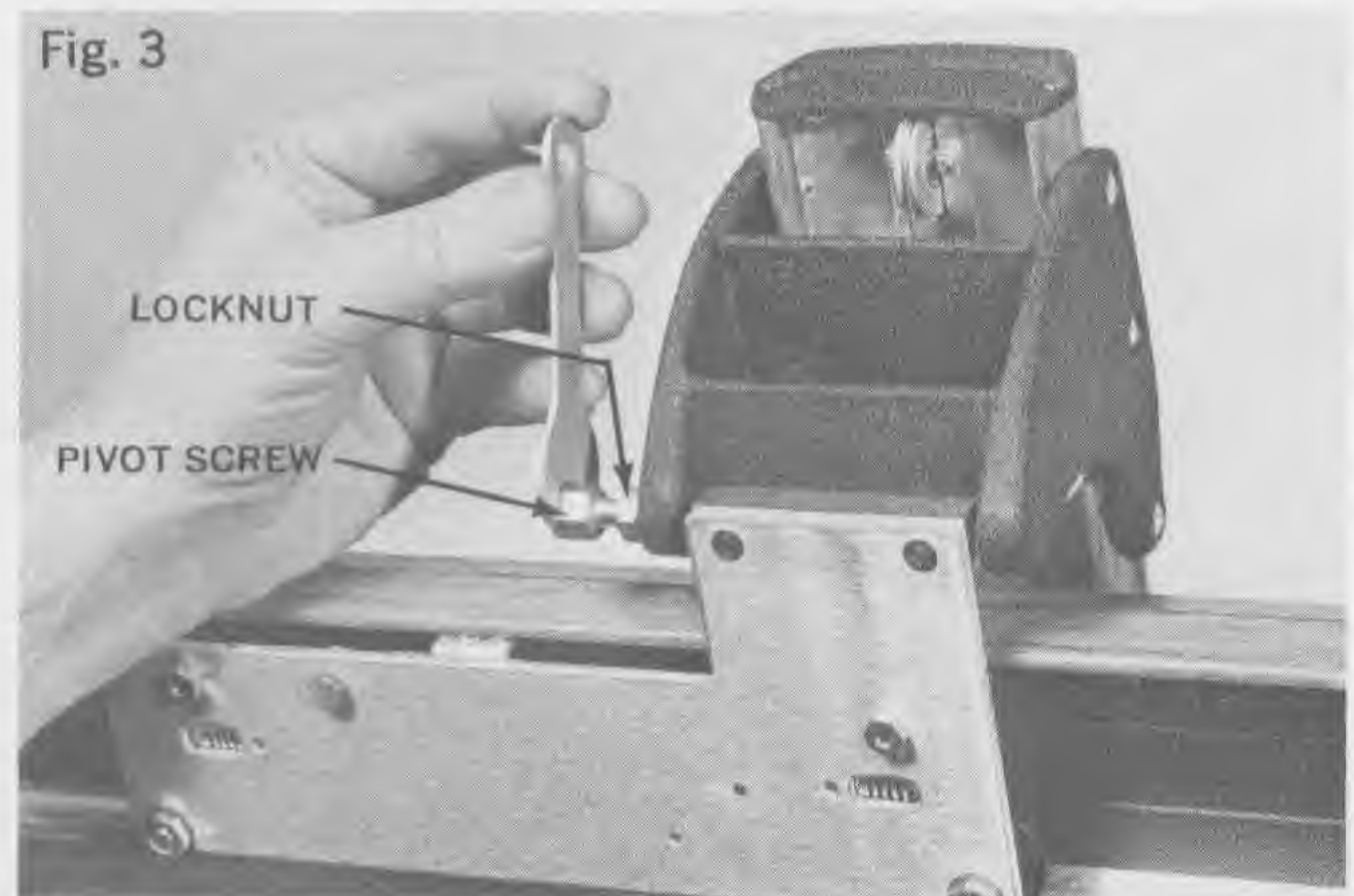
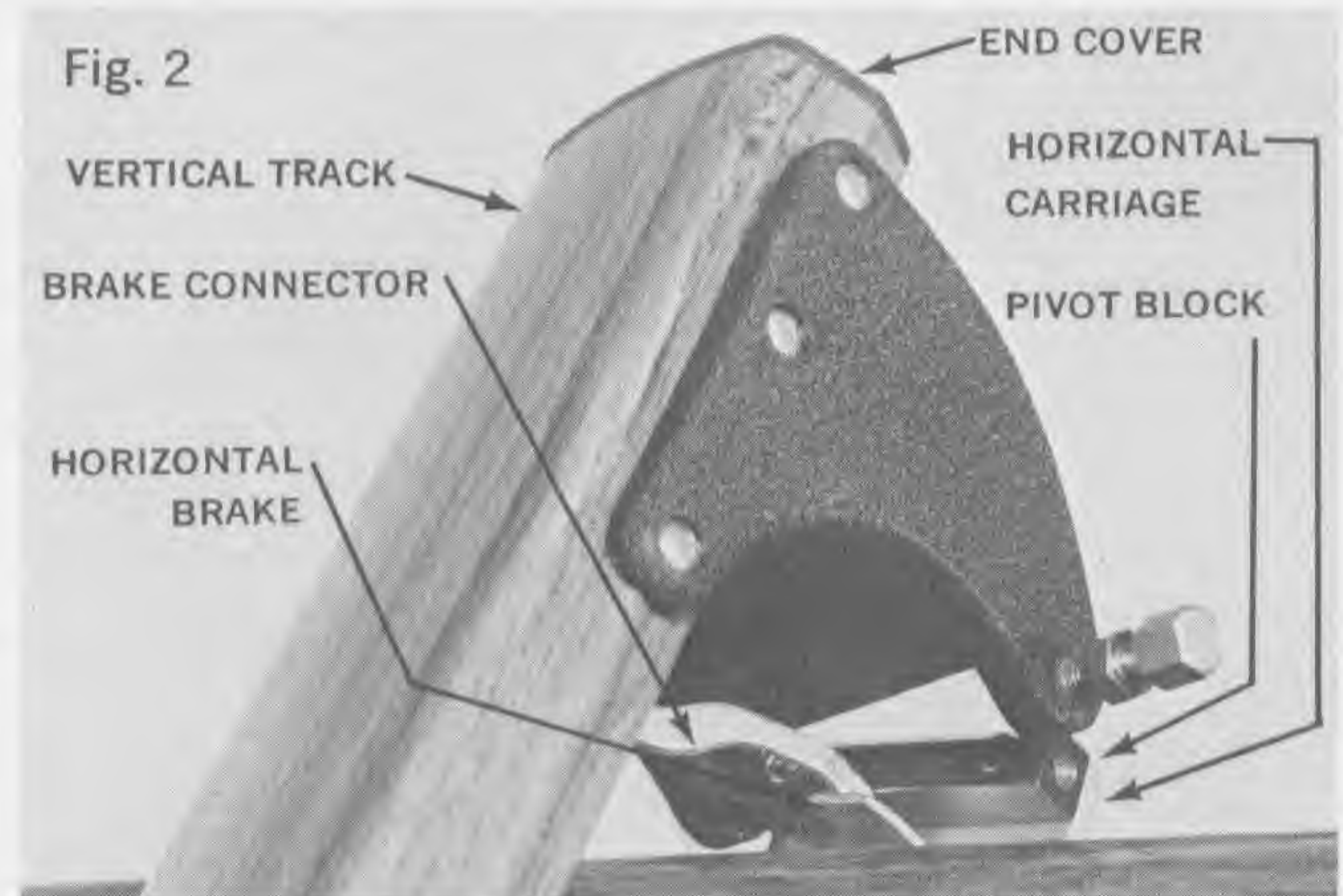
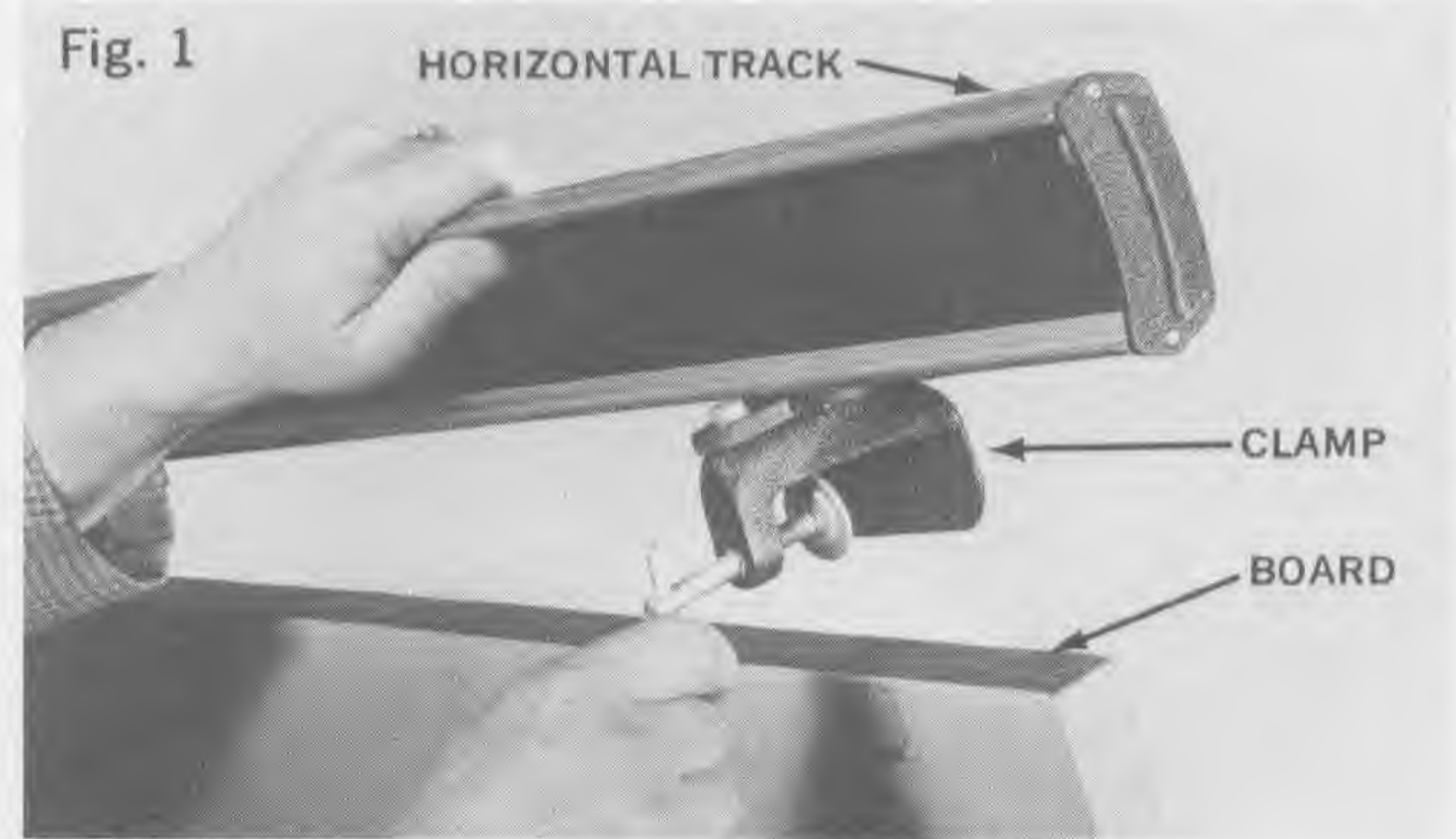
1. (Fig. 1) Attach horizontal track securely to the board as shown, allowing 2 to 3 inches of track to extend over the left hand side of the board when viewed from the front. For left hand machines, the track should extend to the right. If you have a machine which is mounted to the board by screws and support brackets, it is best to screw the support brackets to the track and then locate the screw-hole positions by holding the track alongside the board in its proper position.

2. (Fig. 2) Attach the vertical track to the pivot block on the horizontal carriage. Be certain that the brake connector is above the horizontal brake, as illustrated. Check to see that the serial number stamped on the vertical carriage matches that shown on the name plate.

BE SURE THE VERTICAL BRAKE IS LOCKED WHENEVER THE PROTRACTOR HEAD IS NOT ATTACHED TO THE VERTICAL CARRIAGE.

3. (Fig. 3) Tighten pivot screw securely with hex wrench, taking care that the lock nut is backed away from the bracket to enable the pivot screw to seat firmly in the pivot block. Do not overtighten, as this will cause the horizontal carriage to twist when the vertical track is raised. With the same hex wrench, tighten the lock nut securely.
4. (Fig. 4) Attach the protractor head and pivot joint to the pivot block on the vertical carriage. To adjust the pivot screws to the proper pressure, first make sure that the lock nuts are completely released, and then tighten the two pivot screws (only fingers required) sufficiently to eliminate any looseness in the head but not so firmly as to prevent easy pivoting about the two axes. Set each lock nut by inserting the pin of the scale wrench in a hole of the knurled lock nut and turning until secure.

5. Move the protractor head as close to the top of the board as it will go. If the top surface of the pivot joint is not approximately parallel to the table top, the horizontal track requires adjustment—see "Horizontal Track Elevation" on Page 9. Move the protractor head as near the bottom of the board as it will go. If the pivot joint is not approximately parallel to the table top, the support roller needs adjustment—see "Support Roller—Elevation" on Page 9. If the support roller is not properly positioned on the table, refer to "Support Roller—Board Size" on Page 9.



PREPARATION

Scale Insertion

To insert a scale in the instrument, place it flat on the board in line with the scale chuck on the machine. Firmly press, but do not drive, the chuck-plate on the scale into the chuck (Fig. 6).

Scale Removal

The scale can readily be released by means of the scale wrench as shown in Fig. 5. With the pin side of the wrench downwards, slip the wrench over the screw C and turn clockwise, thus pressing the curved section B strongly against section A of the scale chuck. If no scale wrench is available, the scale can be removed as follows: steady the drafting head with the left hand while the outer edge of the right hand strikes the scale a sharp blow with a sliding movement away from the head.

Scale Alignment

Before using any drafting machine, the scales should be adjusted at right angles to each other. For best results on a track-type machine, the scales should also be aligned with respect to the horizontal track. Both of these operations can be accomplished through the following procedure.

1. Tighten the screw nearest the end of the scale (flat-head screw) on each chuck plate, insert scales in base plate, and press them firmly into place. Release the inner chuck-plate lock-screw (Fig. 6) on the horizontal scale, set the scale near the center of its angular range of adjustment, and tighten the lock screw.
2. Draw a reference line parallel to the horizontal track by:
 - a. Locking the vertical brake and releasing the horizontal brake (see Page 5 for details concerning these brakes).
 - b. Placing pencil point at zero on the horizontal scale and moving drawing pencil *and* protractor head *together* laterally along the board.

CAUTION: Merely drawing the pencil along the scale will not assure a line parallel to the horizontal track.

3. Depends on head model number:
(MODEL 4 HEAD) Release the lock nut on the micrometer base-line screw and turn this screw until the scale is brought parallel to the reference line (Fig. 6). Tighten the lock nut firmly. (MODEL 2 and 3 HEADS) Release the base-line wing-nut and bring the scale parallel to the reference line (Fig. 7). Tighten the base-line wing-nut.
4. Remove the horizontal scale, turn it end for end, and replace it. Loosen the chuck-plate lock-screw, adjust the scale parallel to the reference line, and tighten the lock screw.
5. Index the head 90 degrees clockwise (Fig. 8) and adjust both ends of the vertical scale in the same manner and along the same reference line as in step 4.

You have now established a reference line setting parallel to the horizontal track and have adjusted the scales so that they are perpendicular to each other. For satisfactory results the screws on the scales must be tight and the chuck-plates firmly pressed into the chucks.

THIS SETTING IS IMPORTANT AND SHOULD BE CHECKED PERIODICALLY.

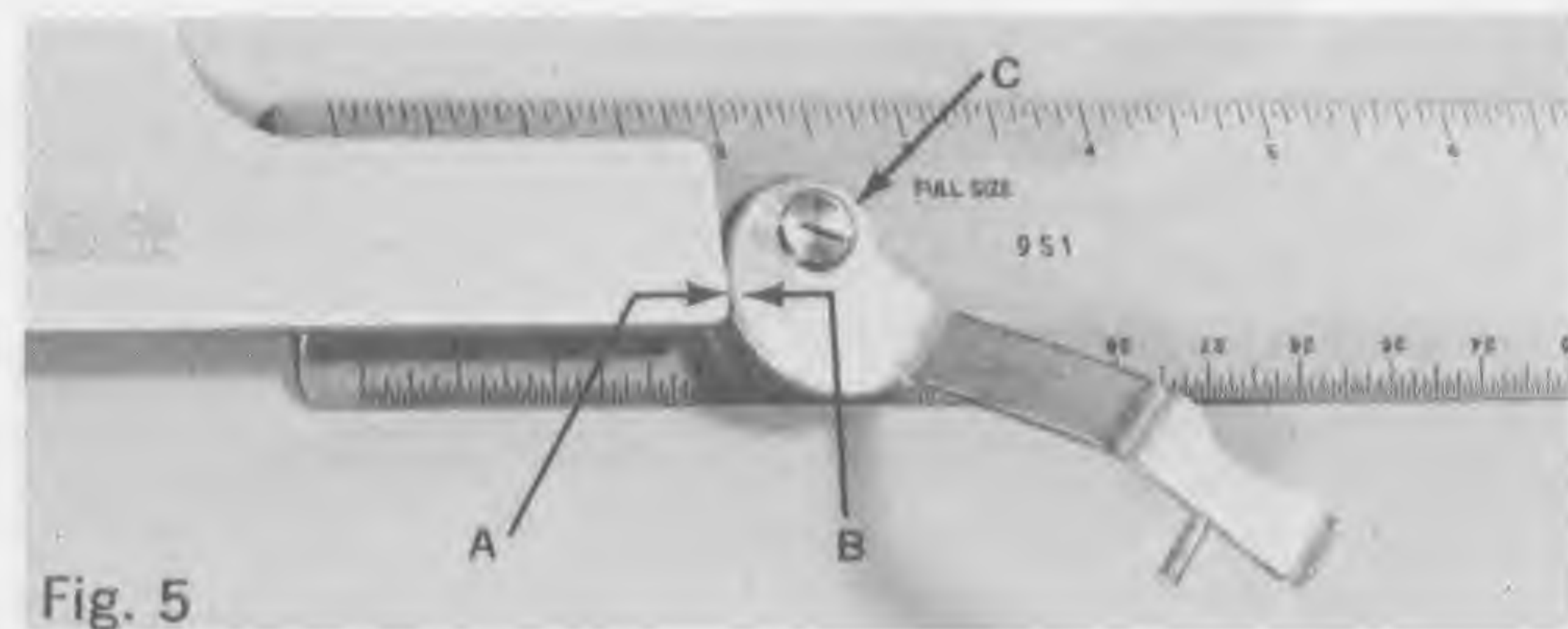


Fig. 5

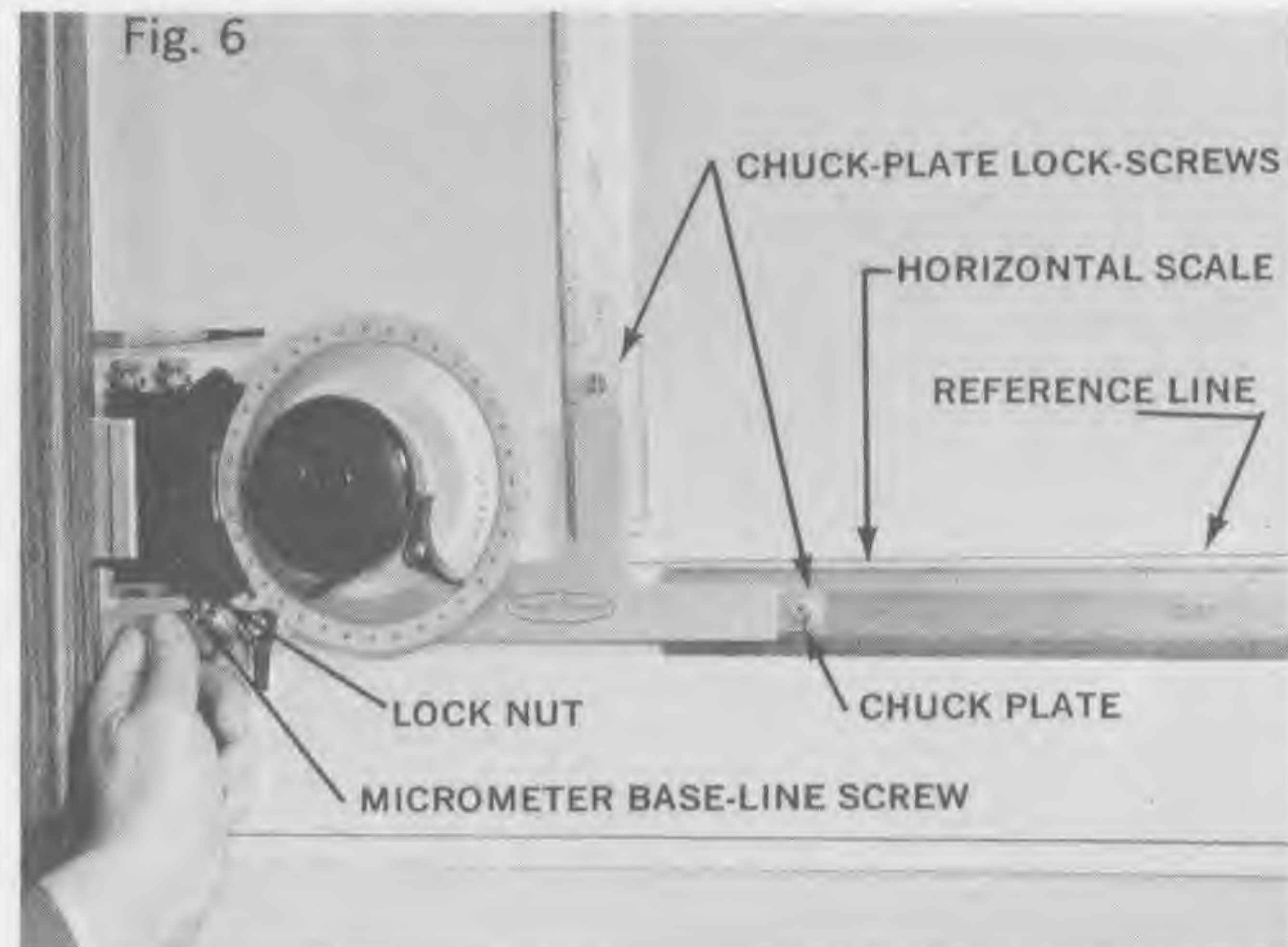


Fig. 6

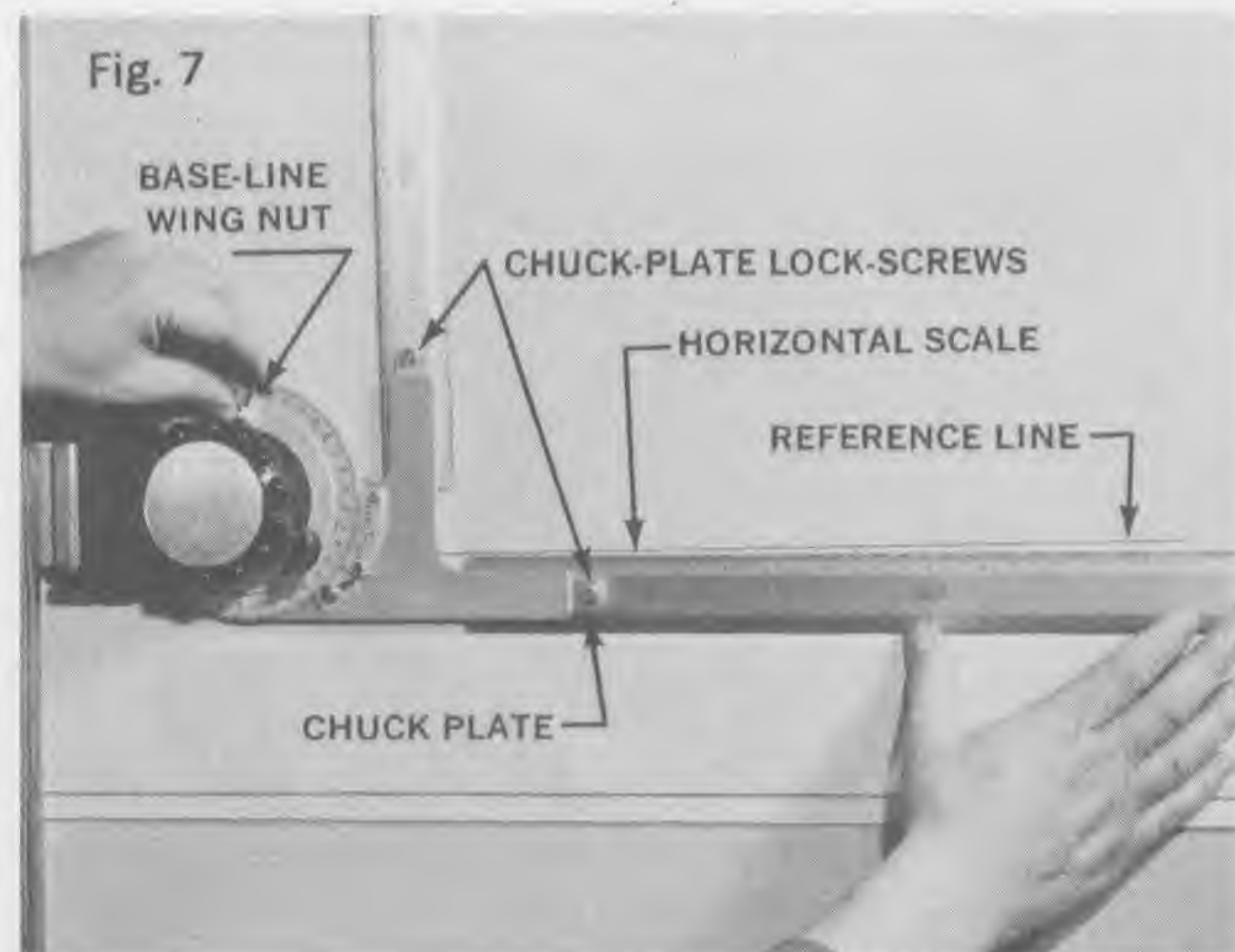


Fig. 7

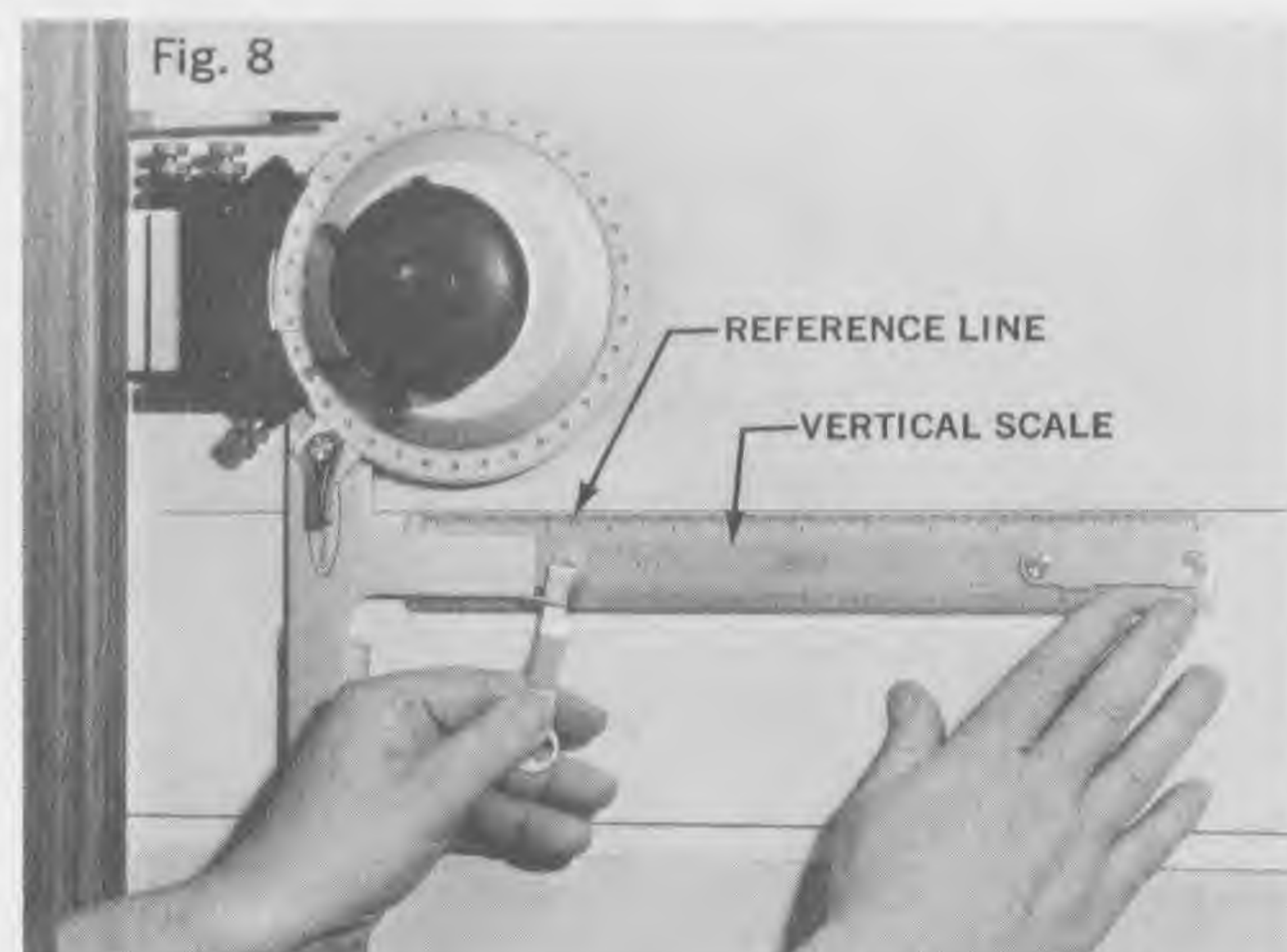


Fig. 8

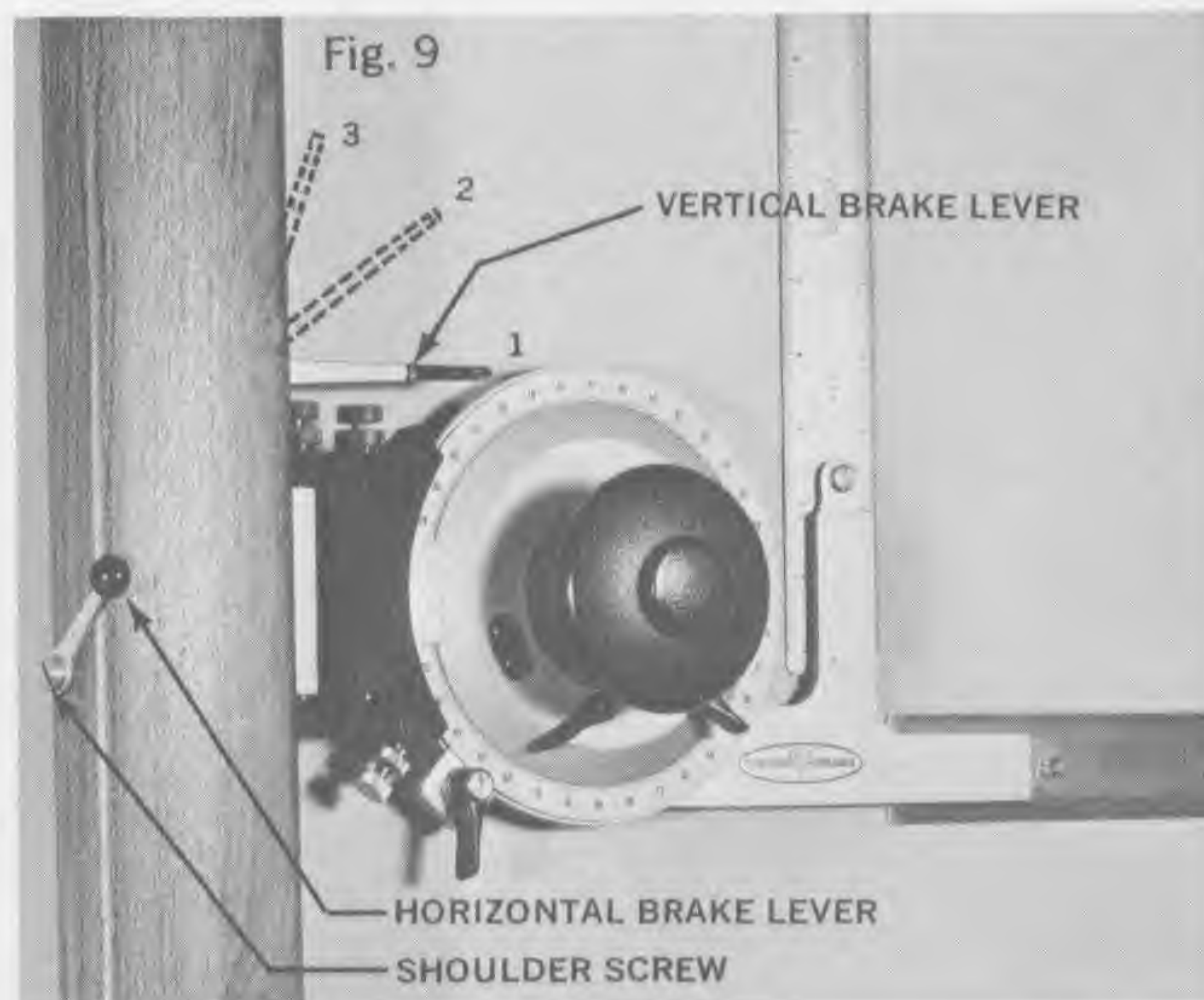
OPERATION

Use of Brakes

All VEMCO V-TRACKS are equipped with horizontal and vertical brakes (Fig. 9). These brakes make it possible to draw long lines in a single motion which we call "tracking." Thus, to track a horizontal line, the vertical brake is locked and the horizontal brake is released; the pen or pencil is then placed against the horizontal scale near the zero mark, and the protractor head and drawing instrument are moved as a unit horizontally across the board. The same procedure is used to track vertical lines except, of course, the horizontal brake is locked and the vertical scale is used. It can readily be seen that, in order for this procedure to produce lines parallel with those drawn with the scale edges, it is essential that the scales be carefully aligned as described on Page 4. It is also essential that the vertical track be perpendicular to the horizontal track. Although each machine is carefully aligned at the factory, re-alignment will be necessary if, for example, a horizontal carriage or vertical track is replaced. The alignment procedure is described on Page 10.

Vertical Brake

VEMCO V-TRACKS are equipped with a special vertical brake which permits great flexibility in the use of the machine. As shown in Fig. 9, there are three stable positions for the brake lever. In position 1 the brake is locked, but it may be released temporarily by pulling the lever downwards. This can be accomplished with one or more fingers of the hand without moving the hand from the control handle. The brake will return to locking position



when the lever is released. When the lever is placed in position 2, the brake is released and will stay that way until it is returned to position 1 manually. Position 3 is another locking position which is used primarily for immobilizing the carriage during shipment or on occasions when the protractor head is detached from the machine.

Horizontal Brake

The horizontal brake lever, used for tracking vertical lines, is also shown on Fig. 9. The brake is pressed toward the top of the board to release and toward the bottom of the board to lock. Instructions for adjusting the horizontal and vertical brakes are given on Page 11.

Use of Vernier

Although most draftsmen are familiar with the use of a vernier, many students and other beginners have never used this convenient device for reading and setting subdivisions of a basic scale unit. The protractors of VEMCO Models 2 and 4 drafting machines are divided into one-degree units with verniers which enable the draftsman to make readings to 5 minutes, while the Model 3 (Civil Engineer's) machines have half-degree protractors and one-minute verniers. The vernier principle will be illustrated with the standard one-degree protractor of the Model 4 head.

1. **READING ANGLES.** We will assume the vernier is set at a positive angle as indicated in Fig. 10A. First note that the reading is between 7° and 8° . Then find the 5-minute mark on the *upper* half of the vernier which is most closely in alignment with a degree mark on the protractor — in this case the 40-minute mark. The correct reading is $7^\circ 40'$. The procedure is only slightly different for reading negative angles — as shown in Fig. 10B. In this case the *lower* half of the vernier is used and the reading is $-4^\circ 25'$.
2. **SETTING ANGLES.** Suppose one wishes to set an angle of $7^\circ 40'$ as shown in Fig. 10A. First release the protractor brake and disengage the indexing mechanism as described above. Rotate the protractor arm until the zero of the vernier is as at 7° . Then slowly rotate the protractor arm counter-clockwise until the 40-minute



Fig. 10

mark on the upper half of the vernier is precisely aligned with the nearest degree mark on the protractor. Finally, lock the protractor brake. Again the procedure for setting negative angles is essentially the same (Fig. 10B) except that the protractor arm is rotated clockwise from the 4-degree mark until the 25-minute mark on the lower half of the vernier is aligned with the nearest degree mark on the protractor.

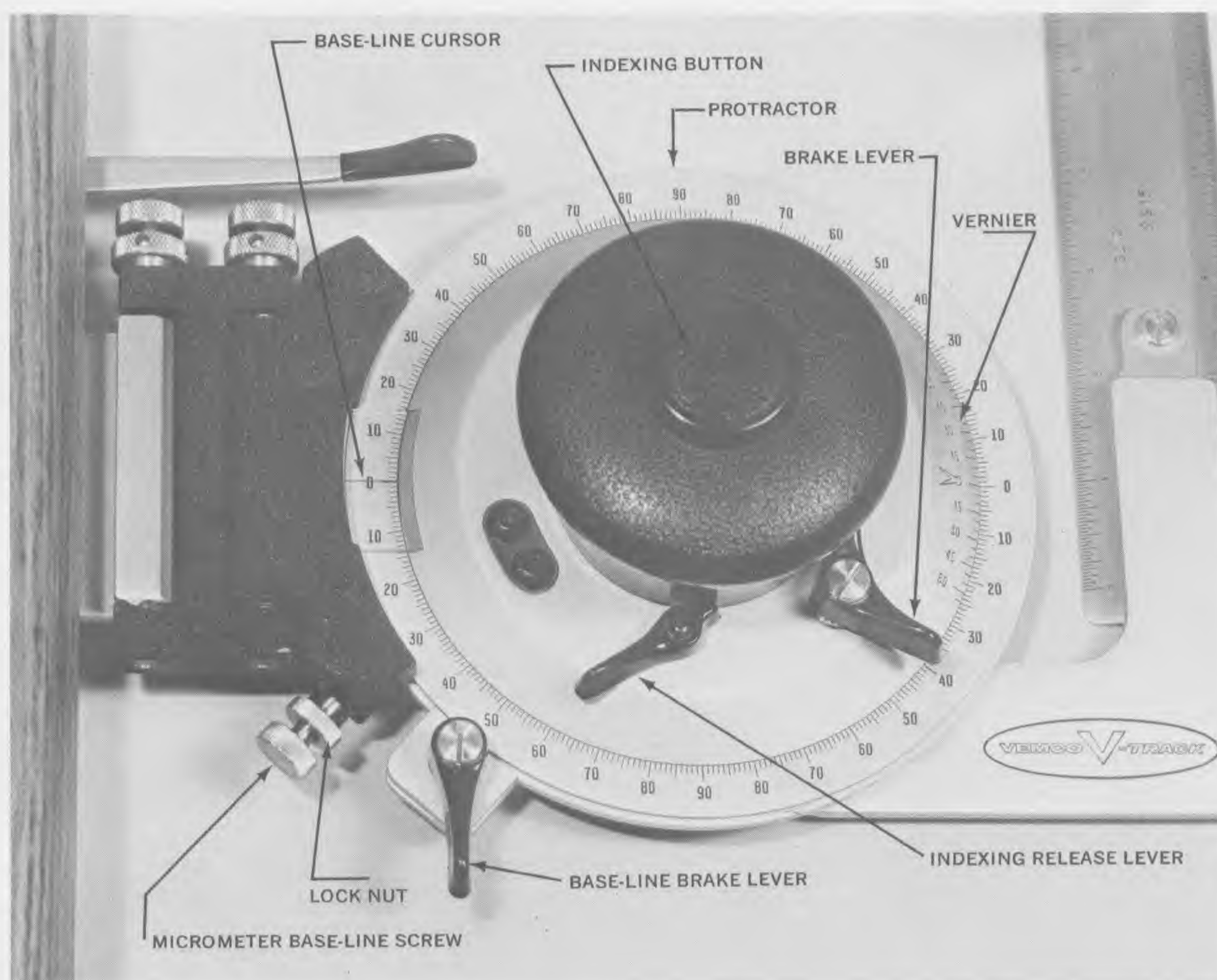


Fig. 11

MODEL 4 VERSAGRAPHIC PROTRACTOR HEAD

Indexing

The protractor arm can readily be indexed at multiples of 15 degrees. Depress the central indexing button (Fig. 11) with the palm of the left hand, and, keeping it depressed, rotate the control handle to approximately the desired position. Then release pressure from the indexing button and allow the indexing mechanism to fall into place and lock.

Intermediate Angles

To set off an angle that is not a multiple of 15 degrees, lock out the indexing mechanism by rotating the index release handle (Fig. 11) clockwise as far as possible toward the control handle. The protractor arm will then be free to rotate. Turn the handle to the desired setting and lock the brake lever (Fig. 11). To re-engage the indexing mechanism, it is only necessary to depress the indexing button and the indexing release handle will flip back into place.

Base-Line Setting

The Versagraphic protractor head has two base-line adjustments. As described in the section "PREPARATION FOR USE" (Page 4), if a V-TRACK is to be used with maximum efficiency on large drawings, it is important that the horizontal scale be adjusted parallel to a "tracked" line. This adjustment can be conveniently made by releasing the lock nut on the micrometer base-line screw (Fig. 11) and rotating the screw. This causes slow and easily controlled rotation of the protractor head. Minor corrections or adjustments to a new base line may also be made with this screw. The lock nut should be tightened after base-line adjustment to prevent accidental loss of alignment.

The user may on occasion find it convenient to make part of a drawing with reference to a base line different from that of the rest of the drawing. To do this, release the base-line brake, rotate the protractor to the proper angle as indicated by the returnable base-line cursor (or align the scale to an existing base line), and tighten the brake. The original base line may then be conveniently recovered by the reverse procedure.

MODEL 2 PROTRACTOR HEAD

Indexing

The baseplate, or protractor arm, can be indexed readily at multiples of 15 degrees. To change the setting from one of these angles to another, first make sure that the protractor brake wing nut (Fig. 12) is released; then press the indexing thumb-piece with the thumb, rotate the baseplate to the desired position, and release the thumb-piece, permitting the indexing mechanism to fall into place and lock.

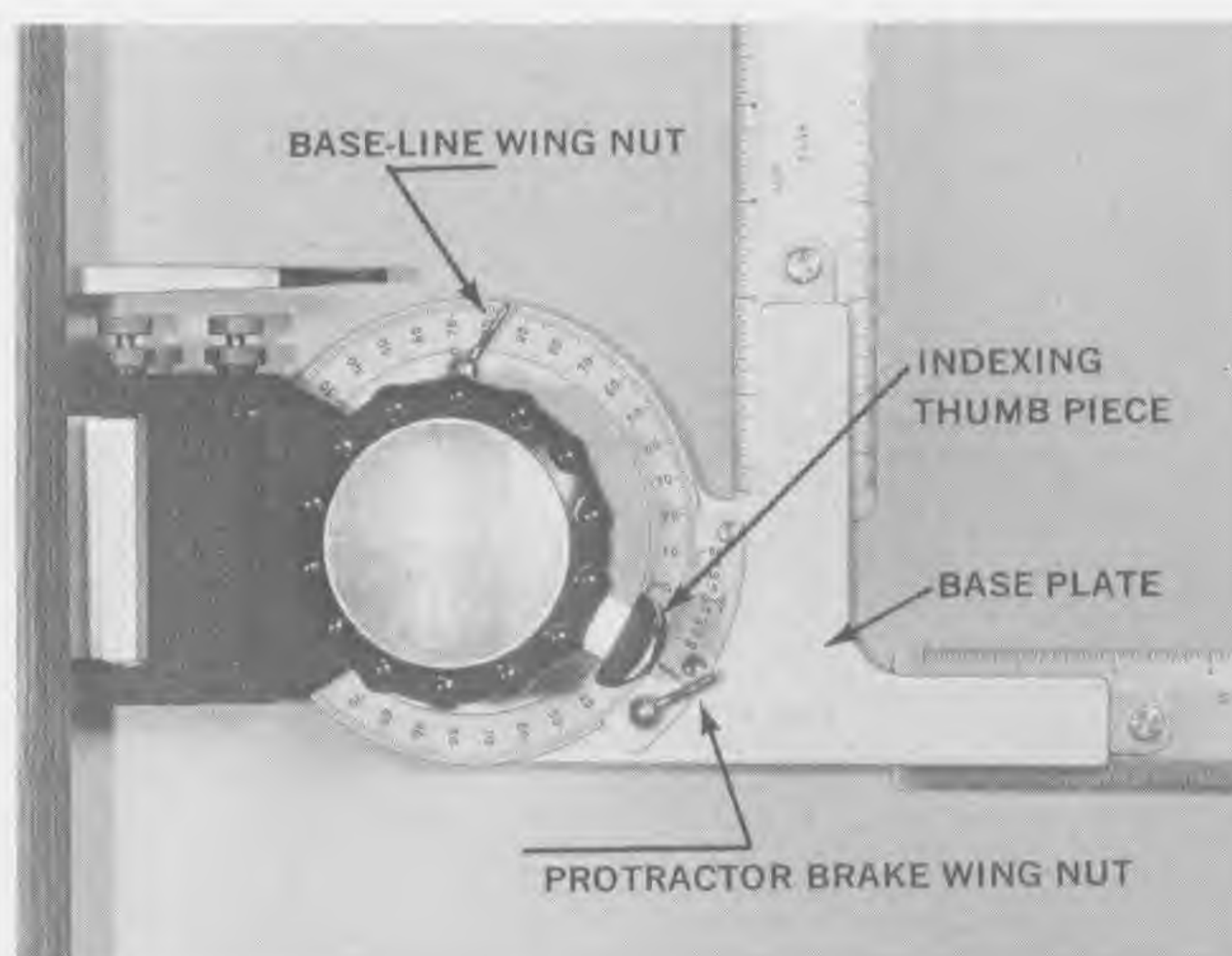


Fig. 12

Intermediate Angles

To set off an angle other than a multiple of 15 degrees, first disengage the indexing mechanism by pressing the indexing thumb-piece, moving it vertically downward, and releasing it, as indicated by the bent arrow in Fig. 13. Rotate the protractor arm with the hand on the far end of the horizontal scale until the desired angle is indicated by the vernier. Now lock the arm by means of the protractor brake wing nut (Figs. 12 and 13). To re-engage the indexing mechanism, press the thumb-piece, move it vertically up, and release it.

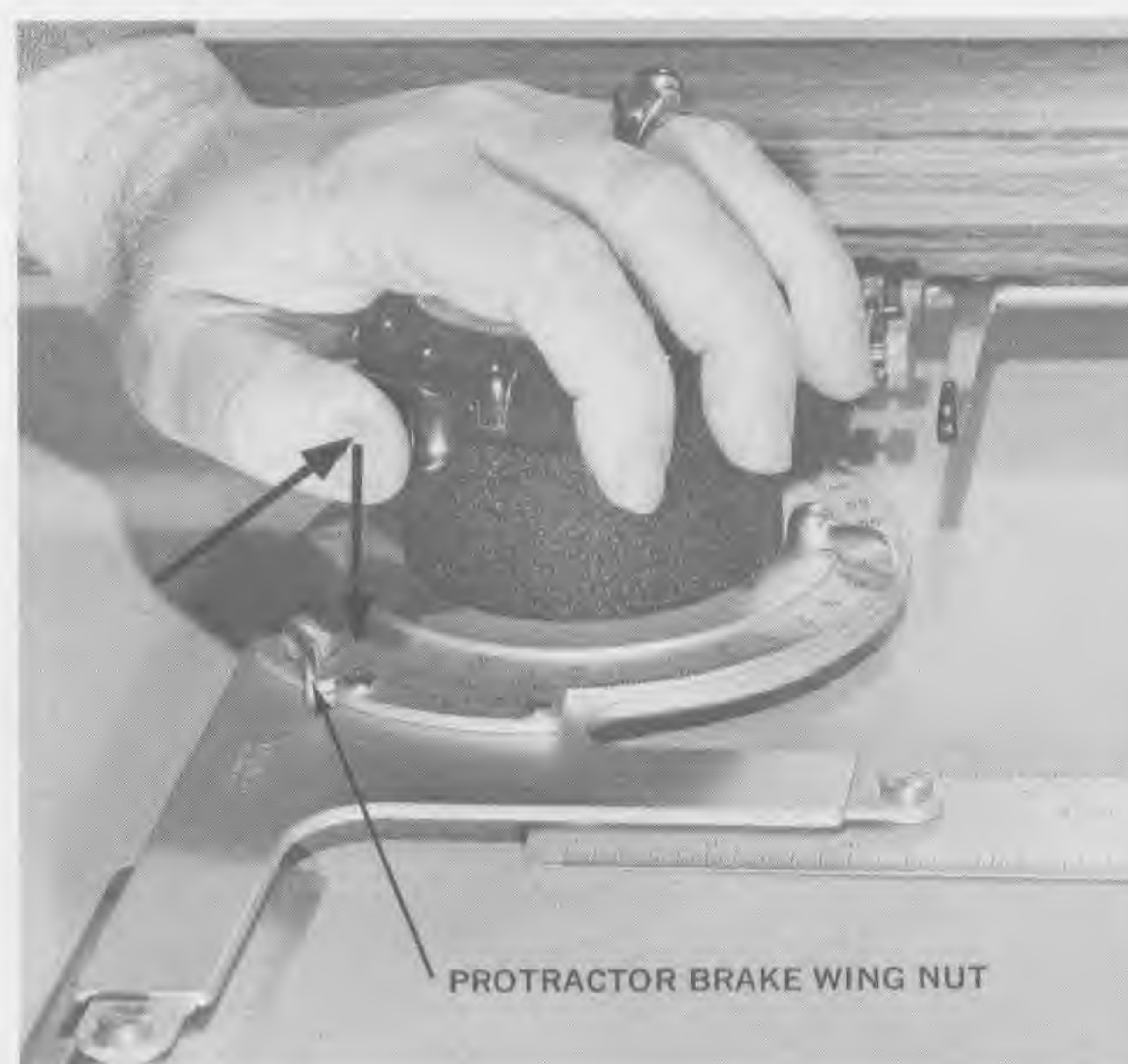


Fig. 13

Base-Line Setting

With the indexing mechanism locked at zero, release the base-line wing nut (Fig. 14). Now set the horizontal scale in alignment with any desired base-line and lock the setting by tightening the wing nut. The base-line wing nut must be tight to prevent the adjustment from slipping and to clear the protractor brake wing nut. It can be loosened, even when very tight, by bearing against the wing nut with the stiff left thumb, and rotating the hand about the handle held in the fingers (Fig. 14).



Fig. 14

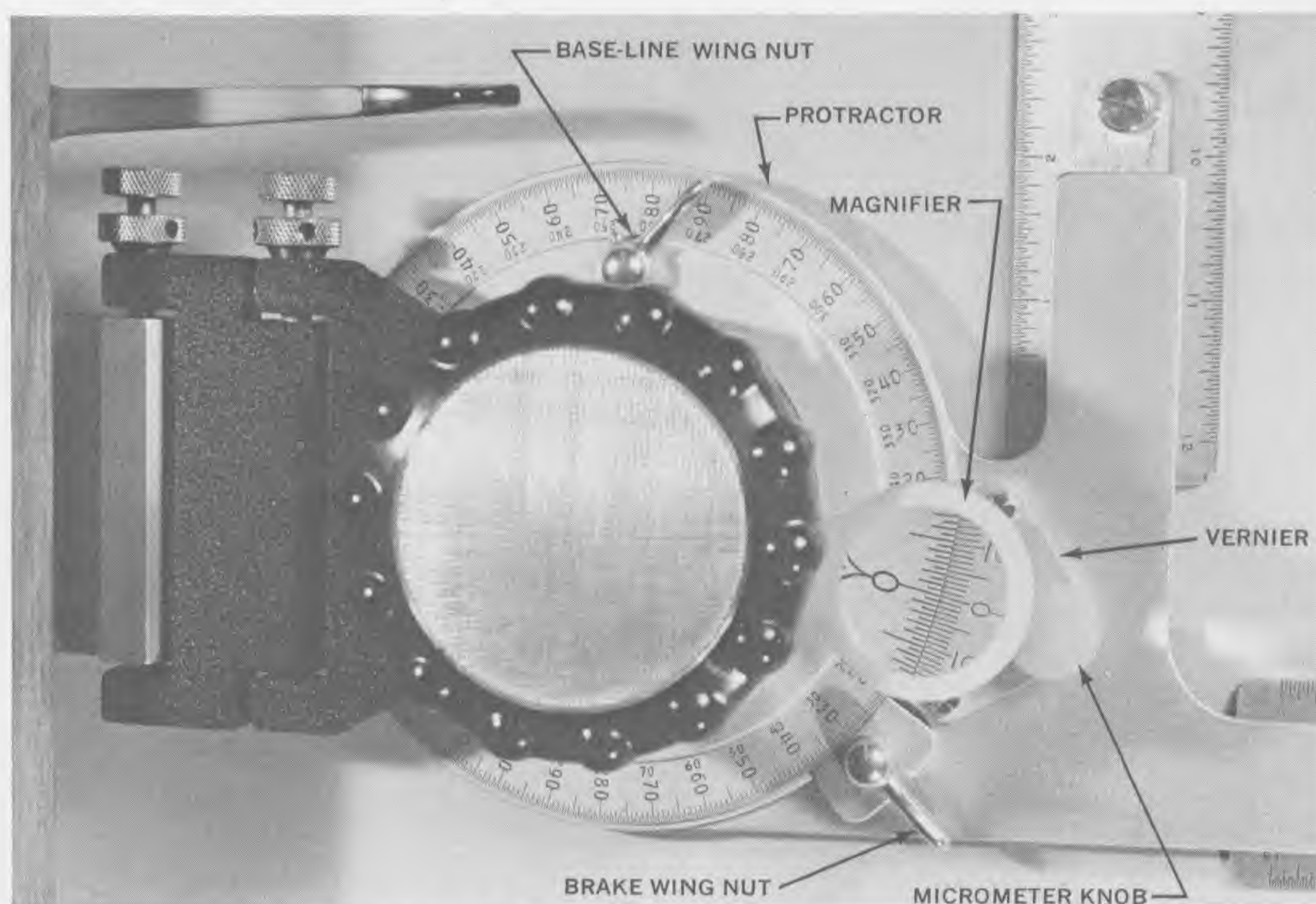


Fig. 15

MODEL 3 (CIVIL ENGINEER'S) HEAD

The construction and operation of the Civil Engineer's (Model 3) protractor head is similar to that of the Model 2. The Civil Engineer's protractor is divided in half degrees and is marked 0-360 degrees in addition to the usual 0-90 degree quadrant numbering. The vernier is made to permit readings accurate to one minute, and the machine is equipped with a magnifying glass. Also, the Civil Engineer's head has no indexing mechanism but is equipped with a micrometer knob and gear to permit precise angular settings to be made easily and quickly.

All of the instructions in this booklet (Model 2 protractor head) except those pertaining to the indexing mechanism apply to Civil Engineer's machines. Although inserting and aligning scales is accomplished in essentially the same manner as described on Page 4, it should be noted that, because the Civil Engineer's machine has no indexing mechanism, it is necessary to use the protractor brake when turning the baseplate 90 degrees for aligning the vertical scale.

This machine duplicates on a map the operations of a transit in the field, the edge of the scale taking the place of the line of collimation of the telescope. The "upper motion" is represented by the motion of the scale arm relative to the protractor. The "lower motion" is represented by the motion of the protractor relative to the pulley. The "upper motion" is clamped, or released, by the protractor brake wing nut (Fig. 15). Similarly, the "lower motion" is clamped, or released, by the base-line wing nut.

The main purpose of the Civil Engineer's machine is to set off accurate angles with respect to a line which may occupy any azimuth in the entire circle. This is accomplished as follows: Release the protractor brake wing nut (Fig. 19) and tighten the base-line wing nut. With the left hand placed on the handle to steady it, place the right hand on

the remote end of the horizontal scale and move it until the vernier is precisely at the zero position of the protractor. The final adjustment may be made with the micrometer knob.

Caution: Never force the micrometer screw (Fig. 15). If the protractor brake wing nut is tight, the parts of the head cannot move, and forcing the micrometer screw may result in some injury to the machine.

Next, tighten the protractor brake wing nut and release the base-line wing nut. Again, with the left hand on the handle, place the right hand on the remote end of the scale and rotate it until it is in precise alignment with the line from which one or more angles are to be set off; then tighten the base-line wing nut. To set the scale at a given angle, release the protractor brake nut and set the vernier at this angle, either by rotating the scale as described above or by means of the micrometer knob.

The user may occasionally find it necessary to adjust to a new base line which has a definite angular relationship with an original base line. This may be accomplished by either of the two following methods:

METHOD 1. Release the protractor brake, set the vernier at the required angle, and rule a line with the horizontal scale. Then return the vernier setting to zero, release the base-line wing-nut and set the horizontal scale on the ruled line.

METHOD 2. If one is not already available, rule a line to represent the original base line. Release the protractor brake, set the vernier at an angle which is the *negative* of the new base-line angle, and tighten the brake. Release the base-line wing-nut and set the horizontal scale along the original base line. A zero vernier reading will now correspond to the horizontal scale being parallel to the new base line.

ADJUSTMENTS

Horizontal Track Elevation (Fig. 16)

Loosen the track adjustment screw and raise or lower the horizontal track until the pivot joint is parallel to the board. Be sure that the protractor head and horizontal scale rest squarely against the board while making this adjustment. Both ends of the horizontal track should be so adjusted and then rechecked.

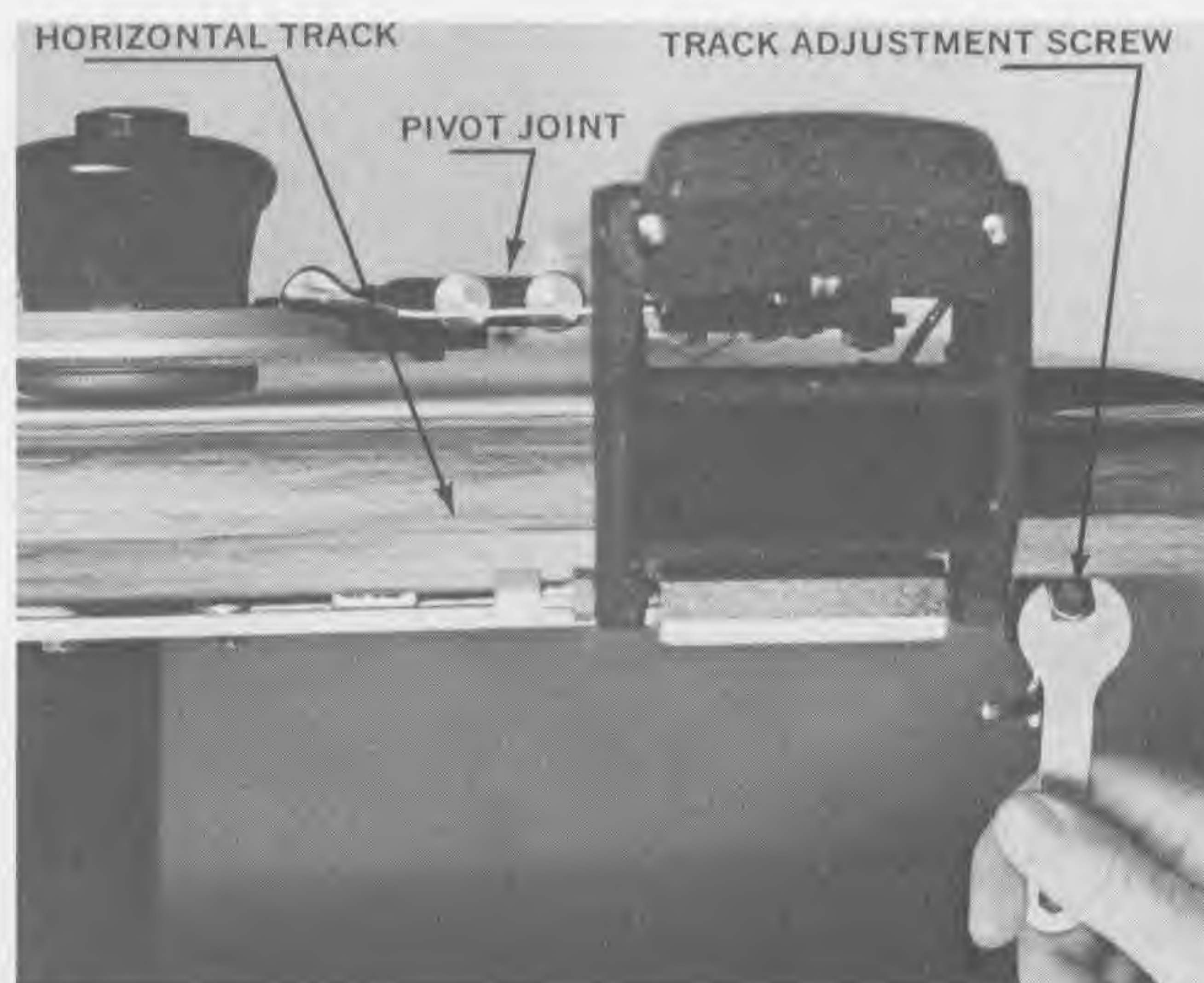


Fig. 16

Support Roller — Elevation (Fig. 17)

Loosen the support roller screw. With the protractor head and horizontal scale resting squarely on the board, hold the track so that the pivot joint is parallel to the board, hold the support roller against the board, and tighten the screw. Double check to be sure the pivot joint is still parallel to the board after this adjustment has been made.

Support Roller — Board Size

The support roller can be adjusted to fit smaller boards or to run on the inside lip of the pencil tray. To adjust, loosen the lock screw (Fig. 17) and move the bracket along the vertical track to the desired location. Be sure the bracket is square with the track and properly seated before tightening the lock screw. Also, check the support roller for proper adjustment (pivot joint should be parallel to the board) if the roller has been reset to run on the pencil tray.

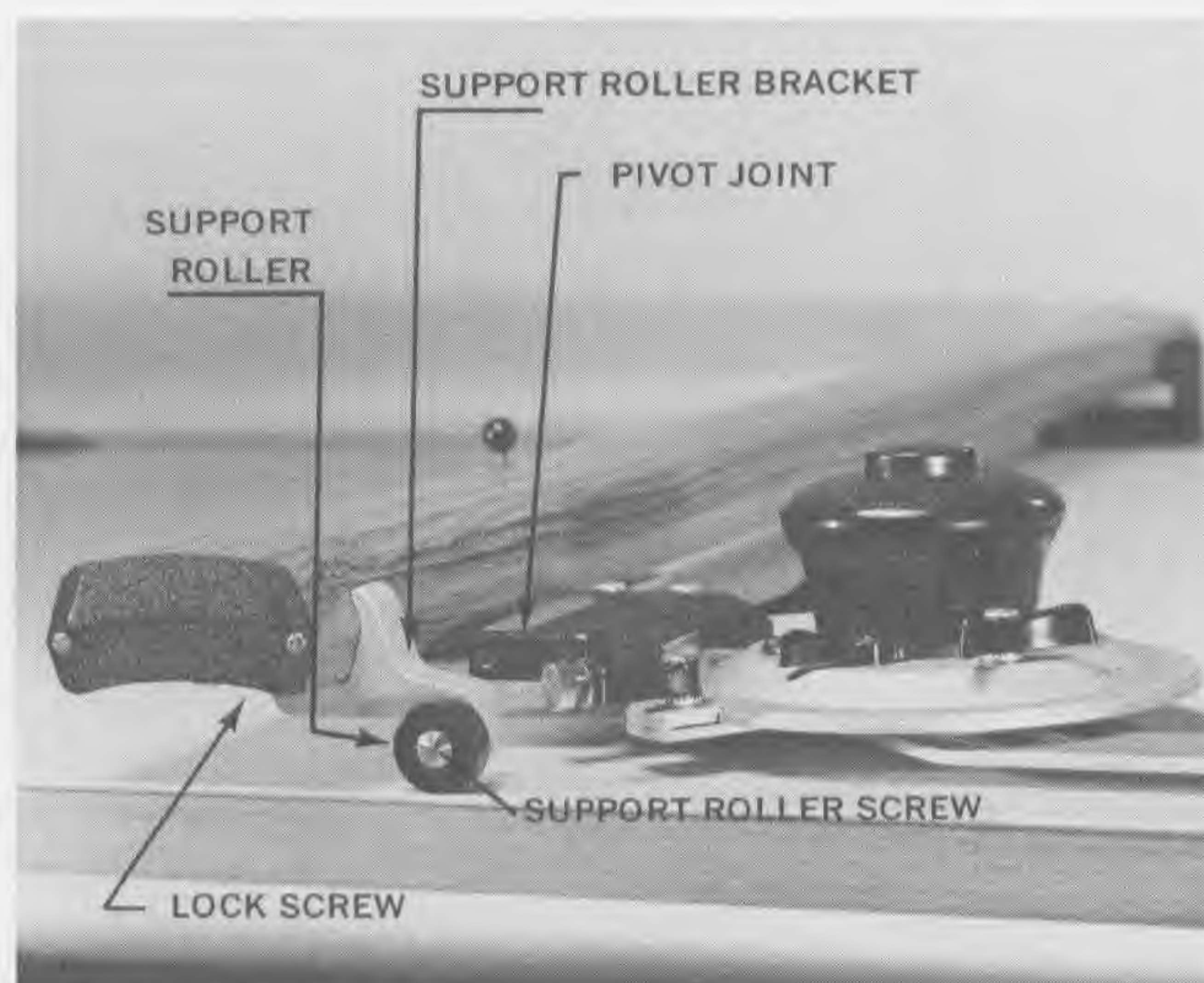


Fig. 17

Wing and L-Nut Adjustment (Model 4)

Because of wear, the user may find that the locking position of the brake lever L-nut or base-line wing nut (Fig. 18) has altered to an awkward position or even to a position in which there is interference with the proper operation of the protractor head. This is an easy situation to correct. Set the brake in the locking position and release the screw on top of the L or wing nut with a screw driver until the teeth on the bottom of the plastic part become disengaged from the mating teeth of the steel nut (Fig. 18). It will then be possible to rotate the plastic part into any desired locking position, and the screw may then be tightened.

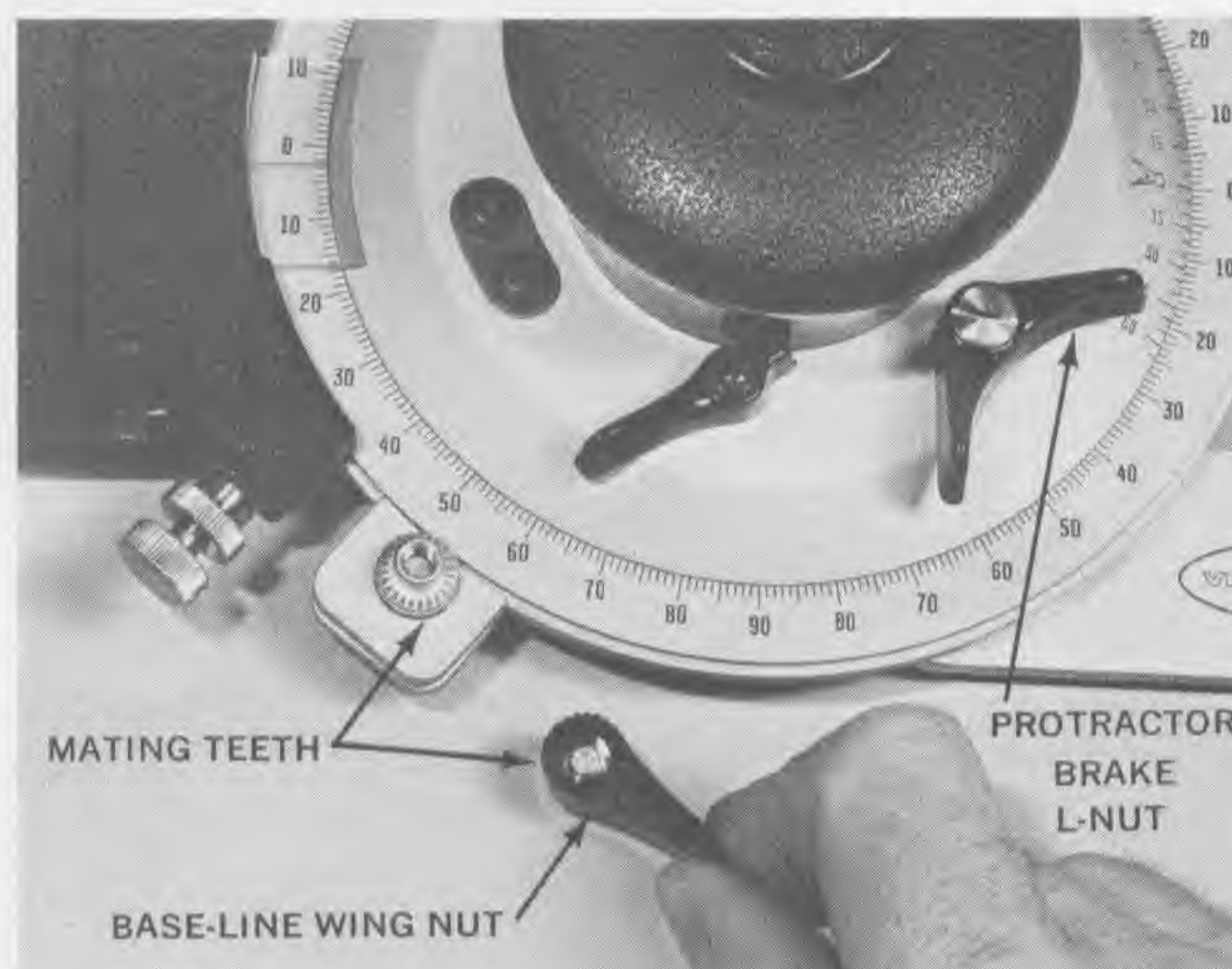


Fig. 18

Vernier Adjustment

Set the zero point of the protractor opposite the zero point on the vernier and lock it there by means of the indexing mechanism. If these two zero points are not exactly opposite each other, a correction is required.

MODEL 4 HEAD. With a $\frac{1}{8}$ " ($\frac{3}{32}$ " on older machines) Allen-head wrench, release the two pawl bearing screws on top of the vernier plate (Fig. 19). While holding the control handle with the left hand, rotate the base plate and protractor until the two zero points are exactly opposite each other. Then tighten the pawl bearing screws very firmly and check to make sure that zero marks remain in alignment.

MODEL 2 HEAD. Loosen the vernier plate screws (Fig. 20) and press the vernier plate away from the protractor. Now insert two small pieces of thin paper between the protractor and either end of the vernier-plate to give clearance; press the latter against the protractor lightly and partly tighten the screws. By lightly tapping with a pencil, or with a small wooden block, slide the vernier-plate until the two zero points are exactly opposite and tighten the screws. Now remove the pieces of paper and the protractor will be found to work sufficiently close to the vernier for good reading and without binding.

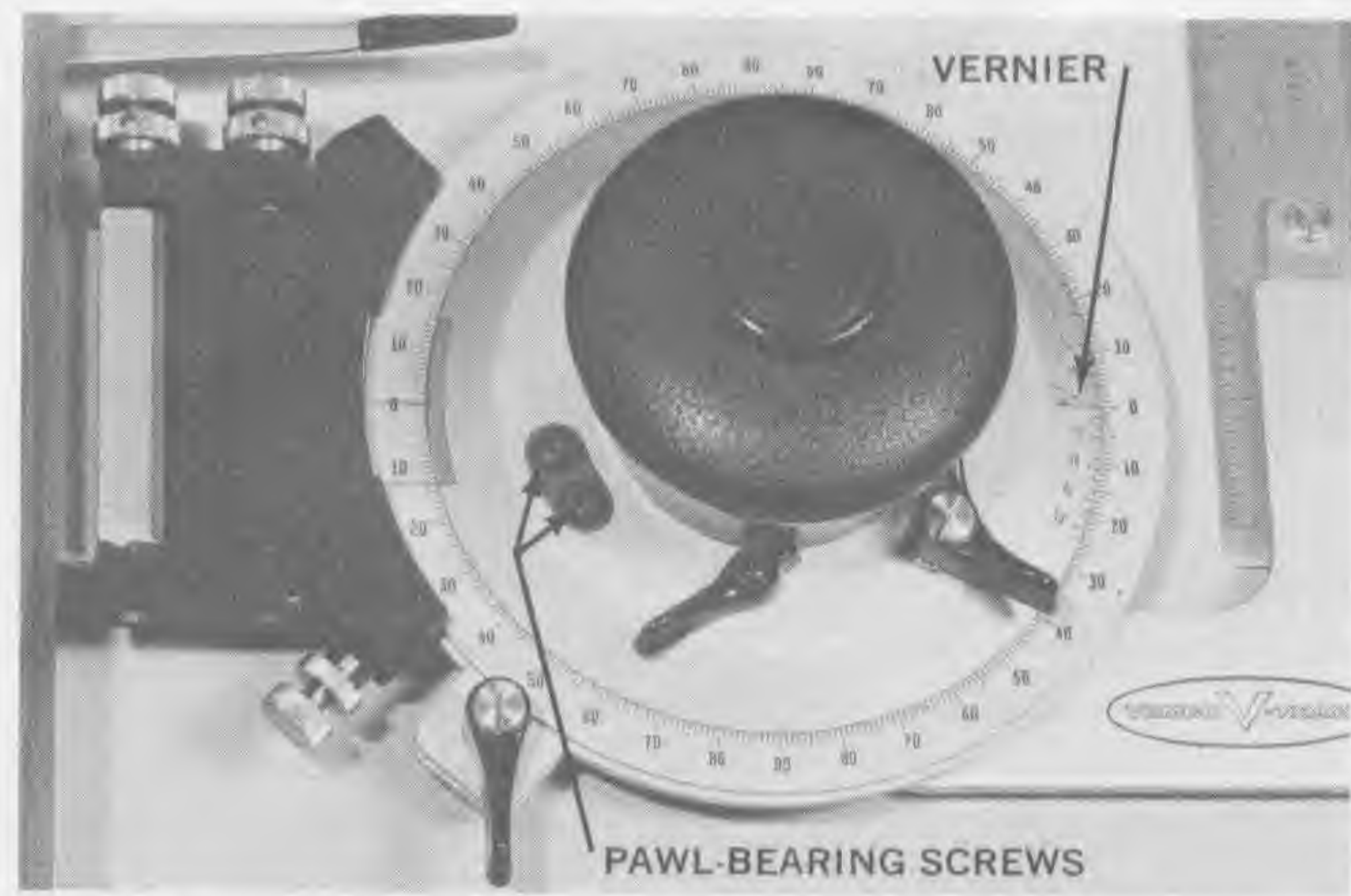


Fig. 19

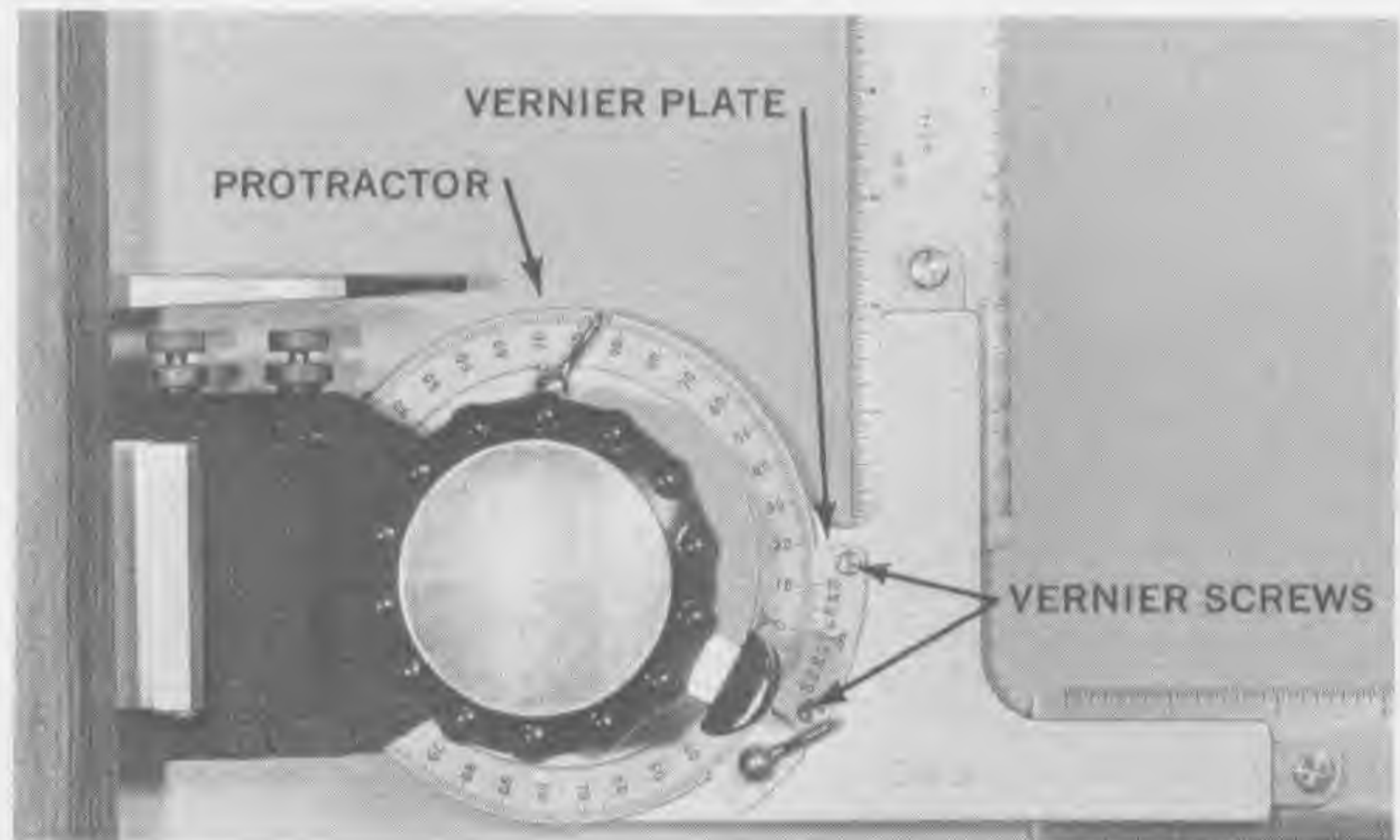


Fig. 20

Vertical Track Alignment

On each machine, the vertical track has been accurately adjusted perpendicular to the horizontal and will rarely require any further adjustment. However, the following test and adjustment will be necessary if a vertical track or horizontal carriage is replaced, or if the vertical track becomes misaligned with its horizontal track.

1. Draw a reference line parallel to the horizontal track as described in step 2 of "Scale Alignment," on Page 4.
2. With the protractor at zero, adjust the base line (Page 6 or 7) so that the horizontal scale is parallel to the reference line.
3. Index the head 90 degrees, lock both brakes, and draw a line perpendicular to the reference line.
4. Return the protractor head to zero, release brakes, and set the zero mark of the horizontal scale precisely over the upper end of the perpendicular line drawn in step 3. Lock the horizontal brake, release the vertical brake, and move the head downward. If the vertical track is in exact alignment, the zero mark on the scale will remain precisely over the perpendicular line over the length of the line. An alignment error of about .010" (the width of a fine line) over the length of an 18" line (about 2 minutes of angular deviation) will be of no practical significance to the draftsman.
5. If the above test indicates a significant alignment error, loosen the lock nut on the eccentric axle of one of the two inner (closest to the board, see Fig. 21) rollers of the horizontal carriage with one of the two open-end wrenches supplied with the drafting machine. Then, with the other wrench, rotate the axle (Fig. 21) to bring

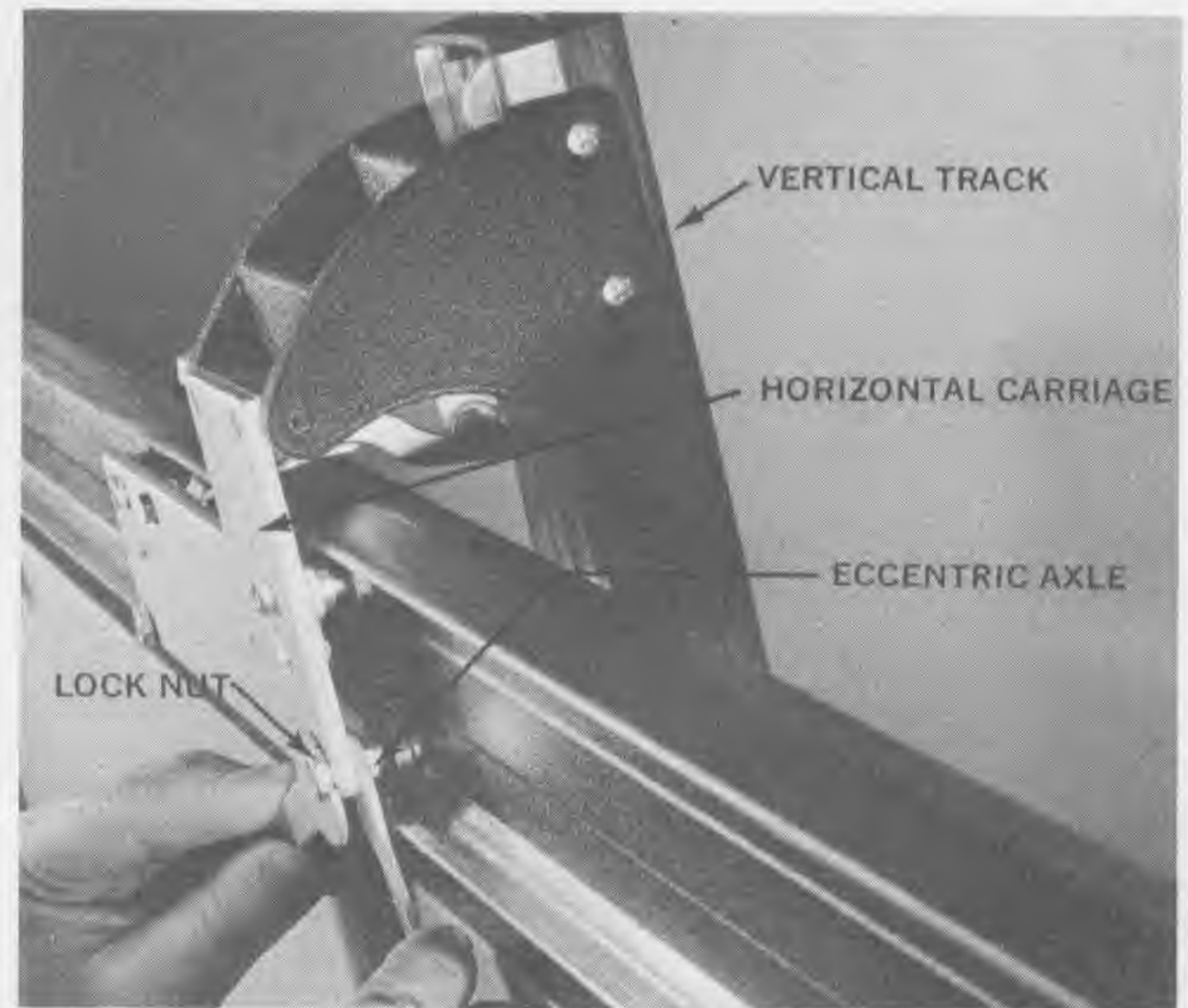


Fig. 21

- the vertical track into alignment by observing the relative positions of the zero mark on the scale (see step 4) and the perpendicular line. Finally, while holding the axle in the corrected position with one wrench, tighten the nut on the axle with the other wrench.
6. Repeat steps 4 and 5 until step 4 indicates satisfactory alignment. If adjustment of one axle fails to yield satisfactory results, try adjusting the other eccentric axle.
7. Test the operation of the horizontal brake. If it fails to hold when in the lock position, or does not release completely, refer to "Brake Adjustments" on Page 11.

Brake Adjustments

If either the horizontal or vertical brake does not hold satisfactorily when in the lock position, or if it drags against the track when released, the situation can usually be corrected as follows:

Horizontal Brake

1. Loosen the brake bolt on the brake eccentric (Fig. 22) with the closed end of one of the two wrenches supplied with the machine.
2. With the brake released, adjust the clearance between the brake lining and the track by rotating the brake eccentric with the open end of the other wrench (Fig. 22). This clearance should be as small as possible such as to avoid dragging of the brake pad on the track.
3. Tighten the brake bolt.
4. Check the brake adjustment. The carriage should move freely with the brake released, and the brake connector (Fig. 23) should have at least .010" of additional free travel when the brake is locked.

Vertical Brake (Fig. 24)

1. Loosen the lock nuts on both eccentric axles of the rollers on the vertical carriage sufficiently to allow the axles to be turned while maintaining some frictional contact with the carriage plate.
2. With the brake in the lock position (position 1 as described on Page 5), rotate both axles until a small amount (about $\frac{1}{4}$ "- $\frac{1}{2}$ ") of free motion of the vertical brake handle is possible. For best results, both axles should be adjusted about the same amount in the same direction so that the vertical carriage will remain parallel to the track.
3. Tighten the nuts on the axles.
4. Check the brake adjustment. The carriage should move freely when the brake is in either the temporary or permanent (Page 5, Fig. 9) release position, and should be held securely when locked.

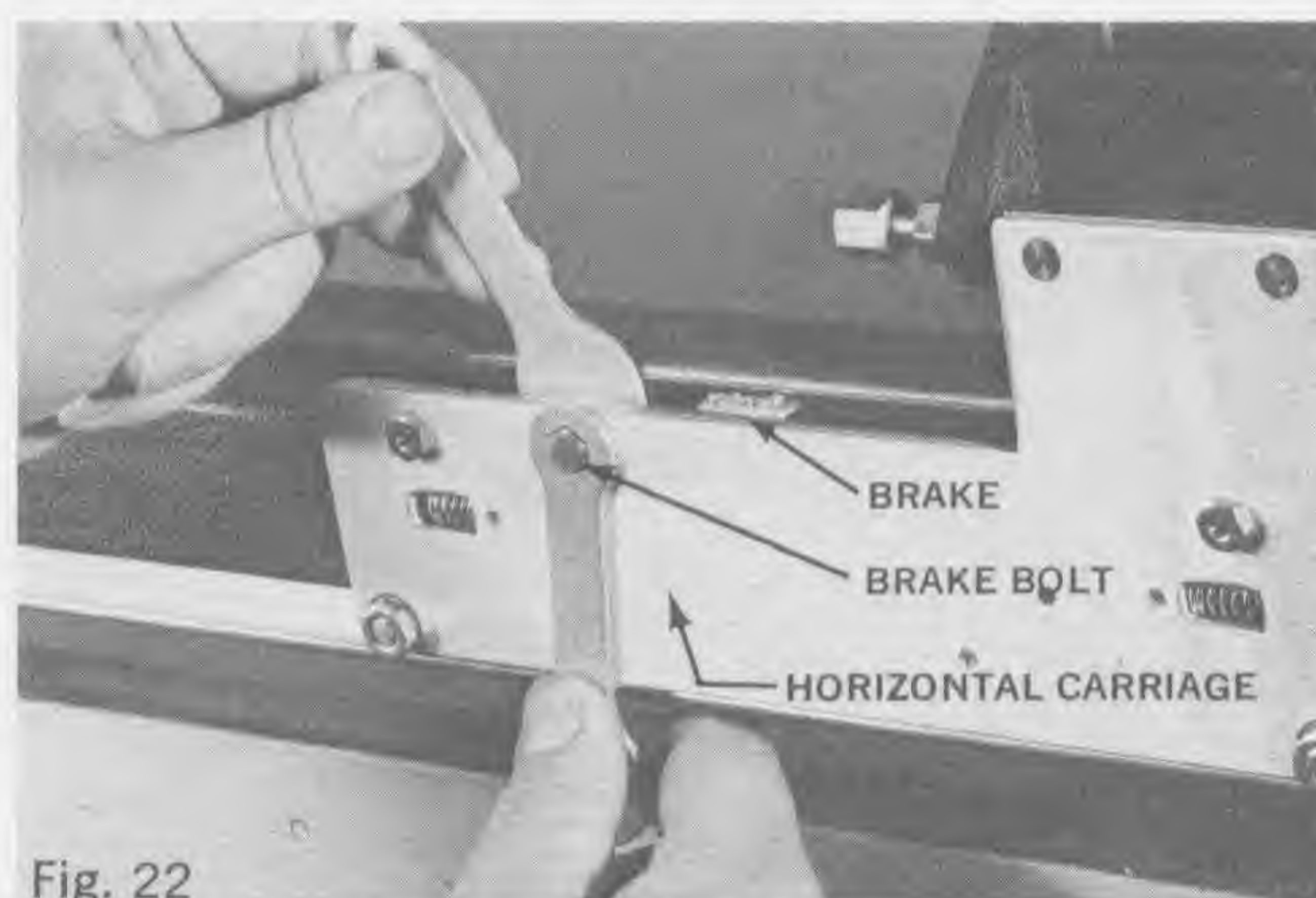


Fig. 22

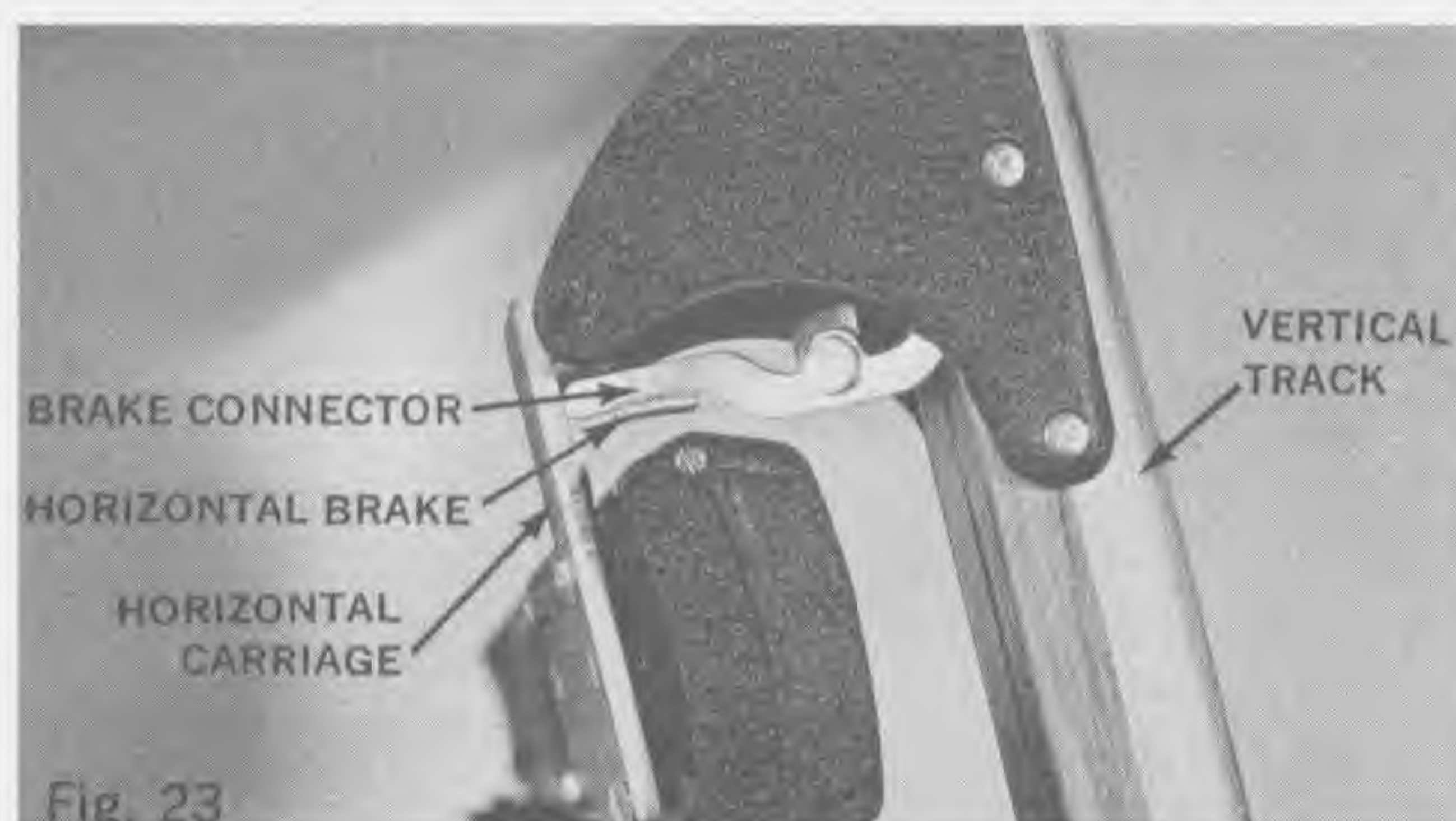


Fig. 23

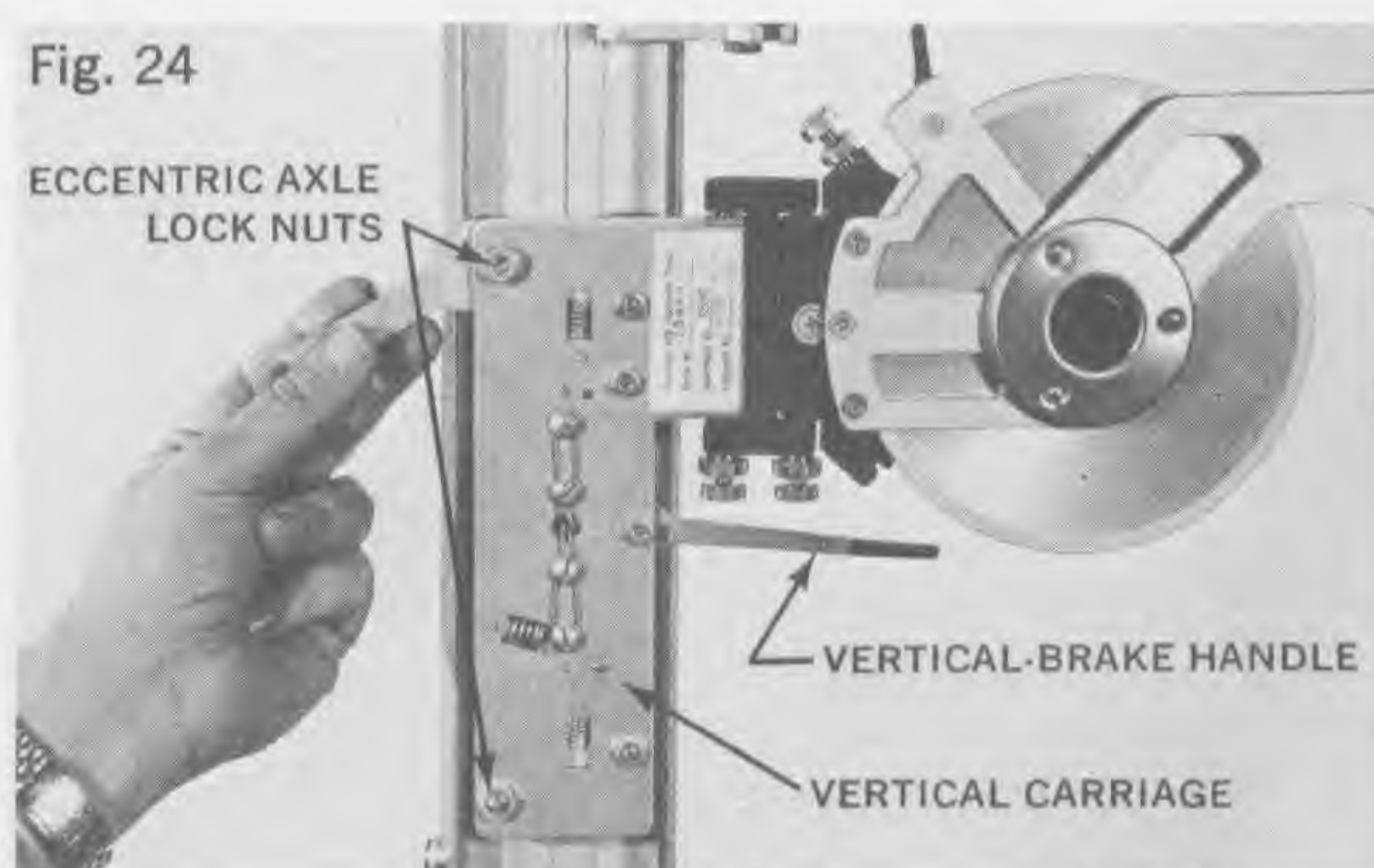


Fig. 24

MAINTENANCE AND REPAIRS

Faulty Brakes

If the vertical or horizontal brake will not hold or will not release, check the following:

1. **BRAKE PADS.** If one is missing, apply a satisfactory adhesive (Eastman 910 is recommended) to one side of a new pad, and, with the brake in the release position, carefully slide the pad between the metal brake shoe and the track, with the adhesive side toward the shoe. Then apply the brake and leave it on for at least 30 minutes. Do not allow any adhesive to get between the brake pad and track.
2. **BRAKE ADJUSTMENTS.** Check the adjustments as described above.
3. **BROKEN OR MISSING PARTS.** If a part in the vertical brake system is found to be defective or missing, remove

the vertical carriage as described on Page 13 and replace the part. If a part in the horizontal brake system which is located on the horizontal carriage is broken or missing, it can also be replaced after removing the carriage as described on Page 13. Also, a damaged brake connector (Fig. 23 above) can easily be replaced or, if bent, it can be straightened by hand.

4. **HORIZONTAL BRAKE LEVER.** If the horizontal brake lever (Page 5, Fig. 9) does not actuate the brake connector (Fig. 23 above) properly, remove the lever by releasing the shoulder screw which holds it in place. Examine the cam part (the steel disc which works against the actuating rod in the track) of the lever. If there is excessive wear, or if there is any looseness between the lever arm and cam, the part should be replaced.

Alignment

If the scales, head, or carriages seem loose, or if, for any reason, the motion of the machine appears faulty, then the following points should be checked.

1. **SCALES.** Make sure that the scales are set firmly in their chucks, that they are aligned as described on Page 4, and that both scale screws are tight. A damaged chuck plate may not seat itself properly in the chuck, and it may be necessary to replace it.
2. **PIVOT SCREWS.** Check the pivot screws which connect the vertical track to the horizontal carriage (Fig. 3, Page 3), and which connect the head to the vertical carriage (Fig. 4, Page 3). Any looseness at these points will result in faulty operation, and steps 3 and 4 on Page 3 should be performed to correct the situation.
3. **MOTION OF CARRIAGES.** A force applied to the machine may cause a roller on the vertical or horizontal carriage to be displaced from its track, which will make the machine operate erratically. Check to make sure that these rollers are properly in their tracks and move smoothly.
4. **PIVOT JOINT.** Make sure that the pivot joint (Fig. 17, Page 9) stays approximately level as the head moves up and down. If it doesn't, adjust the horizontal track and/or the support roller as described on Page 9.
5. **VERTICAL TRACK NOT ALIGNED.** If it appears that the vertical track is not perpendicular to the horizontal track, refer to "Vertical Track Alignment" on Page 10.

Indexing

If the indexing mechanism fails to work, or if there is undue tightness or binding when the scales are rotated, factory service may be required. The user should not attempt to dismantle a Model 4 head, but sometimes the replacement of a small part will correct indexing failure in the Model 2 head. Use the following procedure (Model 2 head only):

TO REMOVE:

1. Turn head upside down and have it positioned so that it will not move accidentally.
2. While holding the skid button in place, unscrew the four shield screws (Fig. 25) and remove the metal shield; carefully lift and remove the skid button.
3. Place a finger on the lock lever (Fig. 25) to hold it in place, and lift and remove the link.
4. Put a finger over the outer end of the lock lever and the lock roller (Fig. 26) and lift the lock lever from its pivot hole (directly under the bend in the lever) by prying it from underneath. Be careful because the coil lock spring (2-182)[†] exerts force on the lock lever unless, of course, this spring happens to be the broken part.
5. When the tension on the lock spring has been relieved, it is possible to disengage it from its two holes and remove it and the lock lever and lock roller.

TO REPLACE:

1. Place end of index pawl in one of the index notches in the index plate (Fig. 25).
2. Put lock roller in place so that it is wedged against both

Scales Not Flat

If the scales do not lie flat as the protractor head is moved around the board, check the following points:

1. **FLATNESS OF BOARD.** The board can be tested for sags and ridges by means of a straight-edge. Badly warped boards will not give satisfactory service and can cause the scales to not lie flat in certain positions.
2. **FAULTY SCALES.** Make sure scales are of approximately the same thickness, are straight, and are properly inserted in the scale chucks. It is possible to straighten an aluminum scale, but a badly warped wooden or plastic scale will probably have to be replaced.
3. **PIVOT SCREWS.** If one or both of the screws on the double pivot joint are too tight, the scales will not stay flat. Refer to step 4 on Page 3 to correct this situation.
4. **FLATNESS OF BASE PLATE.** Release one of the pivot screws, remove the protractor head, and place it on a table bottom-side up. Check the flatness of the base plate with a scale, and look for bending particularly where the scale chucks project from the base plate. With care, the base plate can be straightened by hand.

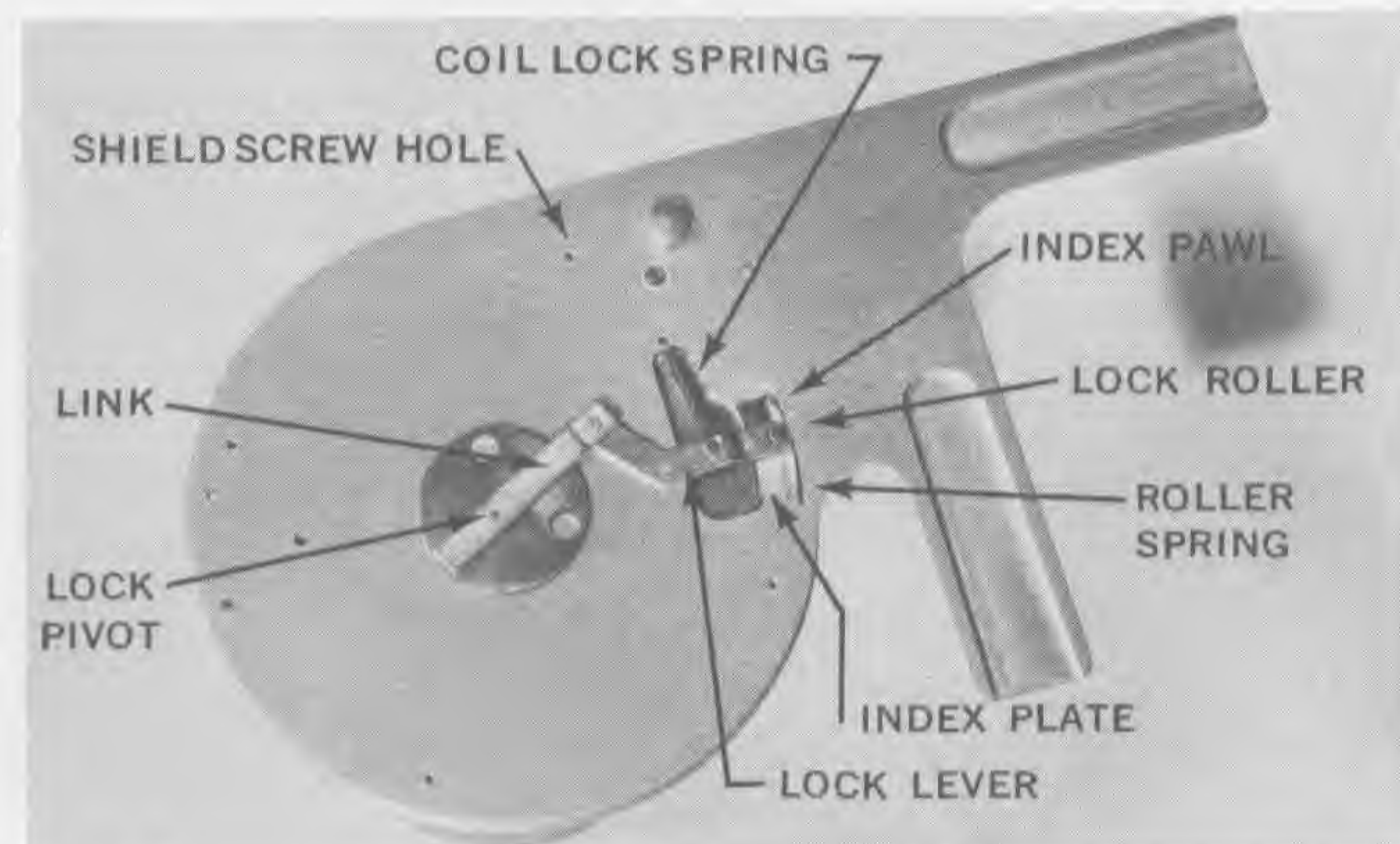


Fig. 25

the pawl and roller spring (Fig. 25). The small end of the roller should face up.

3. Put one end of the coil lock spring[†] into the small hole in the lock lever; place the other end of the spring in the appropriate hole in the base plate (Fig. 25).
4. Slide the slot in the outer end of the lock lever over the small upper end of the lock roller; hold in place with the thumb (Fig. 26).
5. Pull (against the tension of the coil lock spring) lock lever so that its pivot bearing slides into pivot hole in the base plate.
6. Put link in place (Fig. 25).
7. Put skid button in place and, while holding it against the base plate, put shield in place and screw down.



Fig. 26

[†]On machines made after March 1973 (serial numbers greater than about Z156,000), the coil lock spring (2-182) has been replaced by two lock springs (2-282) which are located in the handle. See part drawings on Page 16.

Fig. 27

Horizontal Carriage

A number of conditions, such as a broken carriage roller or damaged horizontal brake, may necessitate the removal of the horizontal carriage. To do this, first remove the vertical track by the reverse of the procedure described in steps 2 and 3 on Page 4. Then remove one of the end covers on the horizontal track (Page 3, Fig. 2) by removing the two screws which hold it on; the carriage can then be taken out from this end. Be careful not to lose the springs which load the two outer carriage rollers.

Vertical Carriage

TO REMOVE:

1. Remove the vertical track by reversing the procedure described in steps 2 and 3 on Page 4.
2. Place the vertical track in a horizontal position so that the counterweight will not drop when the cable is released.
3. Remove the lower end cover and the support roller bracket (see "Support Roller - BOARD HEIGHT" on Page 9).
4. Release the upper cable by loosening the two lower cable screws (Fig. 27). Leave the lower cable attached.
5. Remove the vertical carriage *gently* through the lower end of the track. Cock the carriage a little to one side to get the cable risers past the cable pulley (Fig. 27).

TO REPLACE:

1. While holding the spring-loaded rollers in their proper position, and with the vertical brake in the off position, replace the carriage through the lower end of the track and move it to approximately the center of the track.
2. By means of the upper cable, pull the weight carriage until all of the slack in the lower cable is eliminated.
3. Thread the upper cable through the cable hole in the carriage. A hook made from a paper clip is an effective tool with which to perform this step.
4. Make sure that both cables are seated properly in their pulleys and risers, and pull on the upper cable to eliminate slack from both cables.
5. Loop the end of the upper cable around both lower cable screws, and, while holding the cables to prevent slack, tighten the cable screws firmly.
6. If necessary, cut the cable to leave about 1" of excess cable length, and push the loose end into the cable hole in the carriage.
7. Replace the support roller bracket and end cover, and install vertical track as described on Page 3.

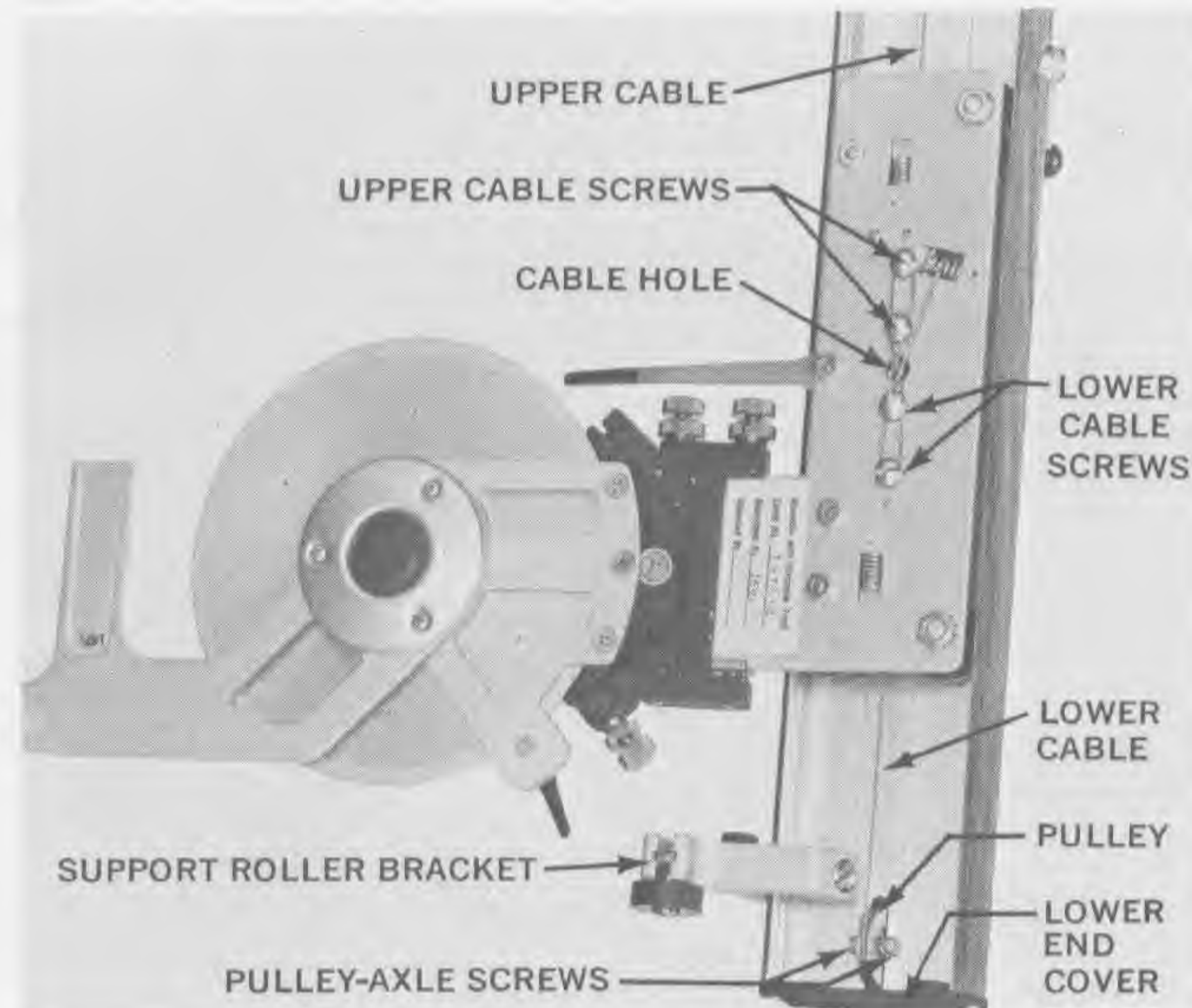
Cables and Counterweight

TO REMOVE:

1. Remove the vertical carriage as described above.
2. Remove the lower cable pulley and axle by loosening the two pulley axle screws (Fig. 27).
3. Tip the track slightly to roll the counterweight carriage to the lower end of the track and remove it through the open end.
4. If necessary, release the lower cable by loosening the two upper cable screws on the vertical carriage, and separate the cables from the counterweight by threading them back through the cable holes.

TO REPLACE:

1. Remove the upper end cover.
2. Thread both cables through the cable holes in the



- counterweight and pull them as far as they will go.
3. Push the upper cable through the counterweight cavity in the vertical track from the bottom and insert the counterweight into the cavity.
4. While holding the spring-loaded rollers in their proper positions, replace the vertical carriage through the lower end of the track.
5. Pass the upper cable properly around the upper pulley and replace the upper end cover as well as the lower pulley and axle.
6. By means of the upper cable, pull the counterweight until it is stopped by the upper end cover. Position the vertical carriage so that its lower end is about $\frac{1}{8}$ " from the lower end of the track and lock the carriage with the vertical brake.
7. Thread the upper cable through the cable hole in the vertical carriage.
8. While holding the vertical carriage and counterweight in the positions achieved in step 6, loop the upper cable around both lower cable screws (Fig. 27), pull the cable taut, and tighten both screws. Make sure that the cable is properly positioned on its pulley and riser.
9. Thread the lower cable through the cable hole in the carriage, loop it around both cable upper screws, pull the cables to eliminate slack and tighten the cable screws.
10. Replace the lower end cover and the support roller bracket, and test the motion of the vertical carriage and counterweight. The limits to the motion should occur when the vertical carriage strikes the rubber pads on the upper end cover and support roller bracket when the bracket is at the extreme end of the track. If the motion is limited by the counterweight striking either end cover, the cables have not been positioned properly. They should then be released and positioned correctly.
11. Install the vertical track as described on Page 3.

Factory Service

If the user cannot correct a problem with his machine, he should contact his dealer or write the factory to explain his problem. If factory service is required, the user should attempt to locate the source of the difficulty and send only the faulty pieces, such as the head, track, carriage, etc. If a machine, or any part of it, is returned to the factory, great care should be taken in packing the machine and all components to protect them from damage in shipment.

CHALKBOARD DRAFTING MACHINE

VEMCO chalkboard machines are available with Model 2, 3 or 4 heads. These machines differ from other V-TRACK machines in that they are mounted differently, are equipped with an adapter block to bring the protractor head down to the level of the chalkboard, and have a different support roller.

Mounting

Chalkboard machines are equipped with brackets which can be attached by screws to the wall above the chalkboard (Fig. 28). In most cases, a better mounting method is first to nail or screw (through wall studs for best results) a length of $\frac{3}{4}$ " x 2" wood strip to the wall directly above the chalkboard and then attach the chalkboard brackets to this strip. In any case, the best technique is to locate the screw holes by holding the horizontal track, with brackets attached, above the chalkboard in the desired position. Then the brackets can be removed from the track and mounted individually in their proper places. The track can then be easily mounted to the brackets.

The vertical track is attached to the horizontal carriage as described in steps 2 and 3 on Page 3.

The protractor head is attached to the adapter block (Fig. 29) by the method described in step 4 on Page 3.

Track Height Adjustment

1. Move the protractor head to the top of the chalkboard.
2. Release brace bolts on mounting brackets (Fig. 28) and adjust the horizontal track until the pivot joint remains parallel to the board throughout the horizontal travel of the vertical track.
3. Tighten brace bolts.
4. Move the protractor head to the bottom of the board.
5. Release the brake bolts (Fig. 29) and adjust the roller leg until the pivot joint is parallel to the chalkboard.
6. Tighten brake bolts.

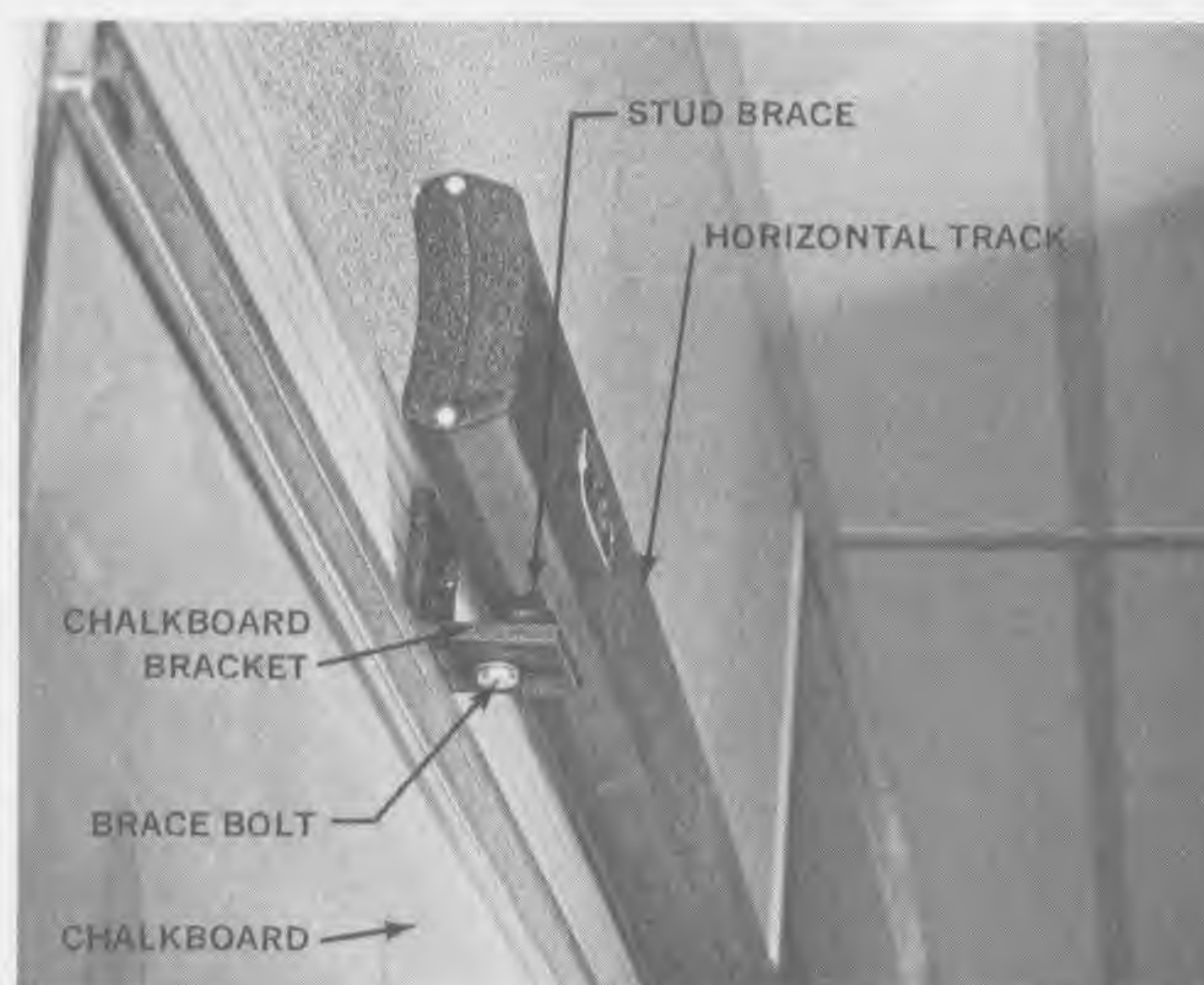


Fig. 28

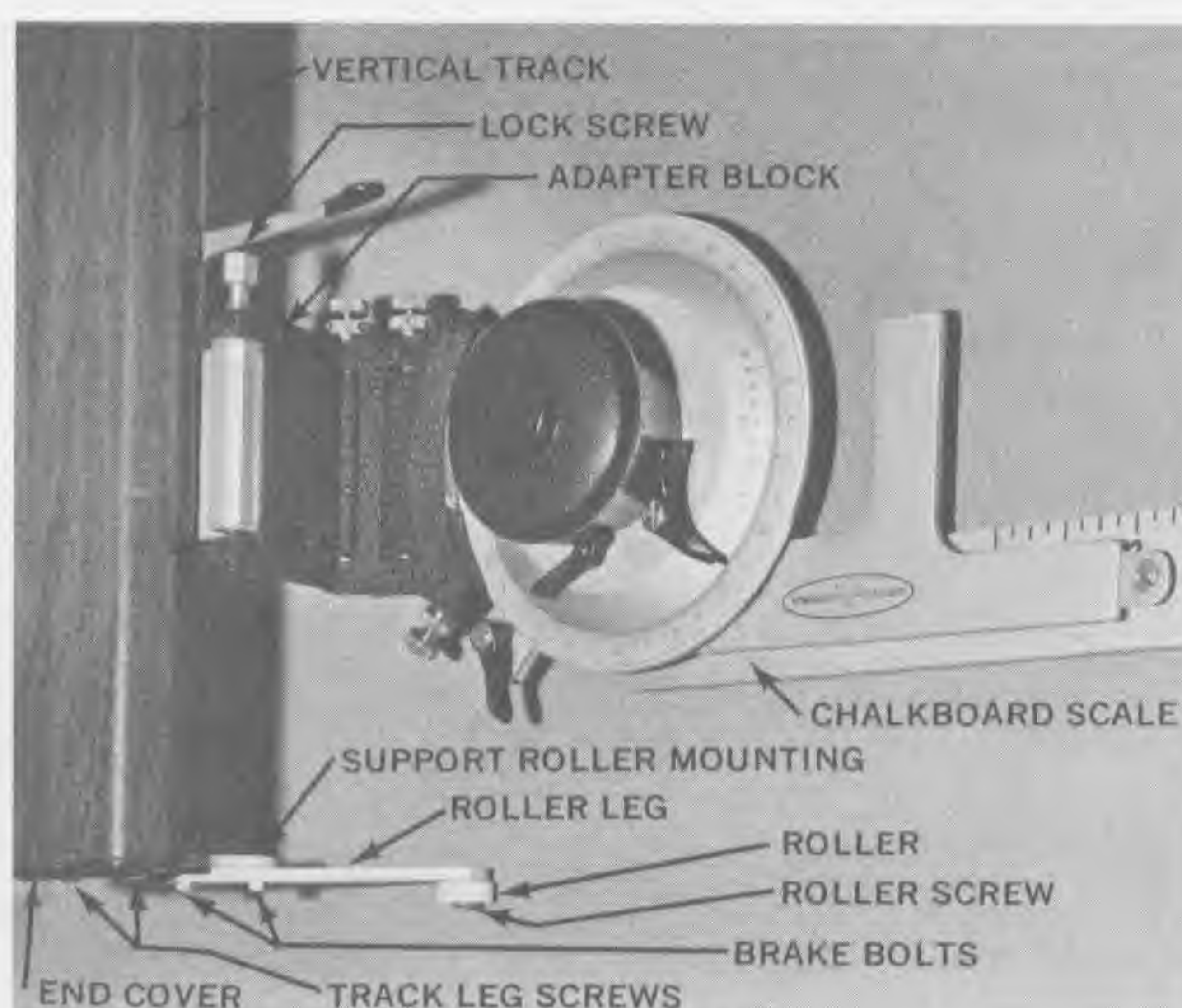


Fig. 29

PARTS LIST

Part No.	Name	Retail Price
49-165 ¹	Chalkboard Adapter Kit (includes all parts required to convert a standard V-Track to a chalkboard machine) ..	\$34.50 ²
ADAPTER KIT INCLUDES:		
49-151 ¹	Adapter Block	7.80
49-154	Chalkboard Scale	6.50
49-158	Lock Screw	1.95
49-160	Chalkboard Support Roller Assembly ..	6.10
49-161 ^{1,2}	Stub Brace	1.95
49-163 ^{1,2}	Chalkboard Bracket	2.60
49-164 ²	Brace Bolt .....	.05

CHALKBOARD SUPPORT ROLLER ASSEMBLY (49-160) INCLUDES:

Part No.	Name	Retail Price
49-14-2	Bumper .....	.05
49-15-1 ¹	End Cover .....	.85
49-26	Roller .....	.65
49-27	Roller Screw .....	.65
49-58 ³	Track Leg Screw .....	.05
49-72 ³	Brake Bolt .....	.45
49-152-1	Support Roller Mounting	1.70
49-153	Roller Leg	1.15

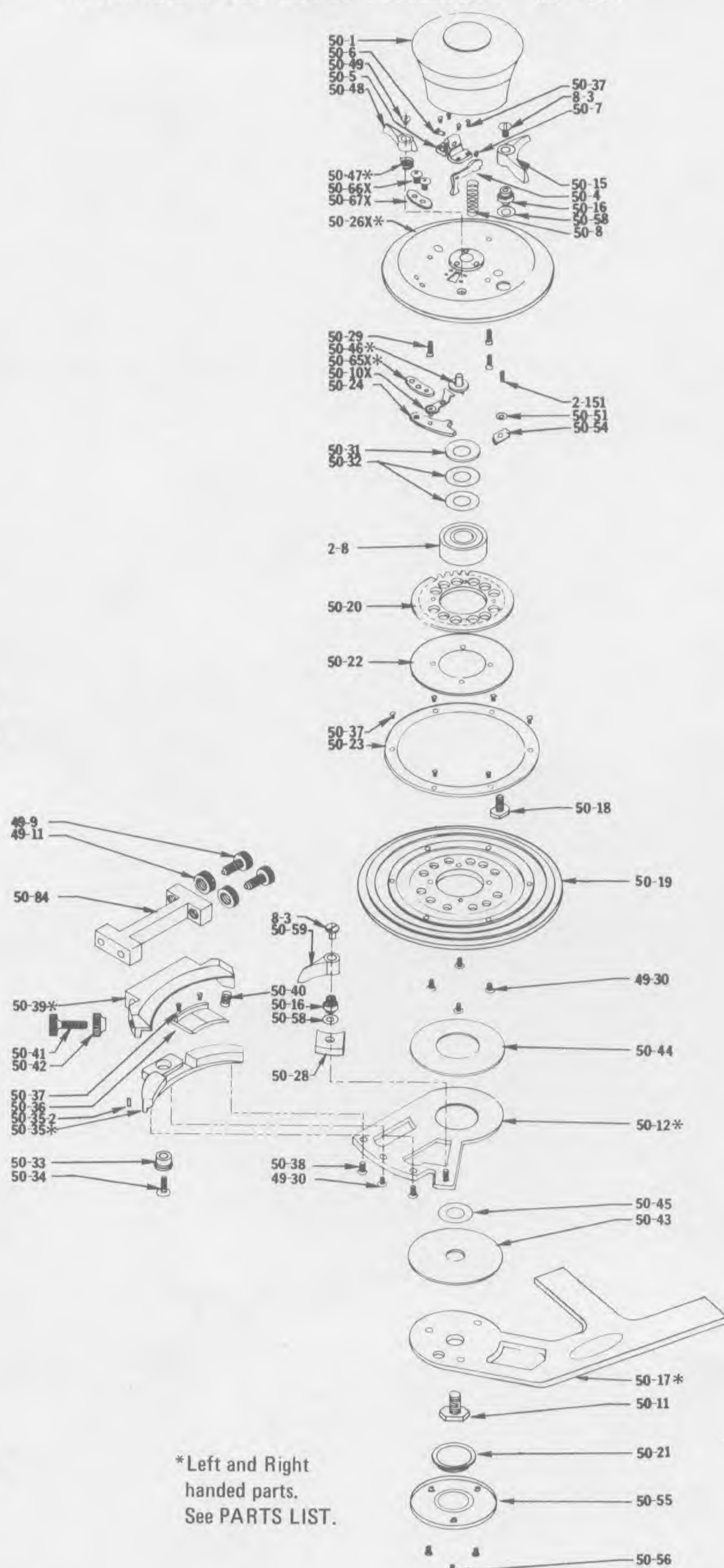
1 Specify color when ordering.

2 Standard kit includes three stub braces, chalkboard brackets, and brace bolts. Since, depending on the machine size, a different number may be required, add \$4.50 to kit price for each additional set required, or subtract \$4.50 if only two sets required.

3 Two of these in each assembly.

VEMCO MODEL 4 V-TRACK DRAFTING MACHINE

VERSAGRAPHIC HEAD ASSEMBLY 50-101



*Left and Right
handed parts.
See PARTS LIST.

50-101 HEAD ASSEMBLY \$90.00
(With Pivot Joint)

PARTS LIST¹

PART NO. ^{2,3}	NAME	RETAIL PRICE
2-8	15 mm Bearing	3.90
2-151	Wing Nut Spring . . . . .	.05
8-3	Wing Nut Screw . . . . .	.30
49-9	Pivot Screw	1.30
49-11	Lock Nut	1.05
49-30	Index Plate Screw . . . . .	.05
50-1	Handle Assembly	5.85
50-4	Lock Lever . . . . .	.15
50-5	Lever Bracket . . . . .	.30
50-6	Lever Pin . . . . .	.20
50-7	Push Nut . . . . .	.05
50-8	Lock Spring . . . . .	.25
50-10X	Link . . . . .	.45
50-11	Spindle Bolt . . . . .	.80
50-12	Head Plate Assembly	4.20
50-12LH	Head Plate Assembly LH	4.20
50-15	L Nut . . . . .	.60
50-16	Brake Nut . . . . .	.60
50-17	Base Plate	6.80
50-17LH	Base Plate LH	6.80
50-18	T Slot Screw	1.10
50-19	Protractor	26.00
50-20	Index Plate	4.55
50-21	Skid Button	1.05
50-22	Brake Disc . . . . .	.60
50-23	Brake Ring . . . . .	.60
50-24	Index Pawl . . . . .	.65
50-26X	Vernier Plate Assembly	22.40
50-26XLH	Vernier Plate Assembly LH	22.40
50-28	Brake	1.80
50-29	Handle Screw . . . . .	.05
50-31	Vernier Spacer . . . . .	.05
50-32	Vernier Shim (Specify thickness .003, .005, .010, .015) . . . . .	.05
50-33	Pivot Bushing . . . . .	.40
50-34	Pivot Screw . . . . .	.15
50-35	Witness Bracket (Incl. 50-35-2 Wear Button)	4.20
50-35LH	Witness Bracket LH	4.20
50-35-2	Wear Button . . . . .	.05
50-36	Witness Plate	1.95
50-37	Witness Plate Screw . . . . .	.05
50-38	Witness Bracket Screw . . . . .	.05
50-39	Adjustment Bracket	6.50
50-39LH	Adjustment Bracket LH	6.50
50-40	Adjusting Spring . . . . .	.05
50-41	Adjusting Screw	1.55
50-42	Lock Nut . . . . .	.65
50-43	Spindle Spacer . . . . .	.25
50-44	Protractor Shim (Specify thickness .003, .005, .010) . . . . .	.30
50-45	Bearing Shim . . . . .	.05
50-46	Release Cam Assembly	1.55
50-46LH	Release Cam Assembly LH	1.55
50-47	Release Spring . . . . .	.65
50-47LH	Release Spring LH . . . . .	.65
50-48	Release Handle . . . . .	.60
50-49	Release Handle Screw . . . . .	.20
50-51	Brake Shim (Specify thickness .003, .005, .010, .0125, .015) . . . . .	.05
50-54	Brake Shoe . . . . .	.20
50-55	Shield . . . . .	.80
50-56	Shield Screw . . . . .	.05
50-58	Brake Washer . . . . .	.05
50-59	Wing Nut . . . . .	.60
50-65X	Pawl Bearing Assembly	1.00
50-65XLH	Pawl Bearing Assembly LH	1.00
50-66X	Pawl Bearing Screw . . . . .	.25
50-67X	Pawl Bearing Washer . . . . .	.15
50-84	Pivot Hinge	6.20

¹We recommend that the user not attempt to disassemble the 50-101 head because special tools are required for assembly.

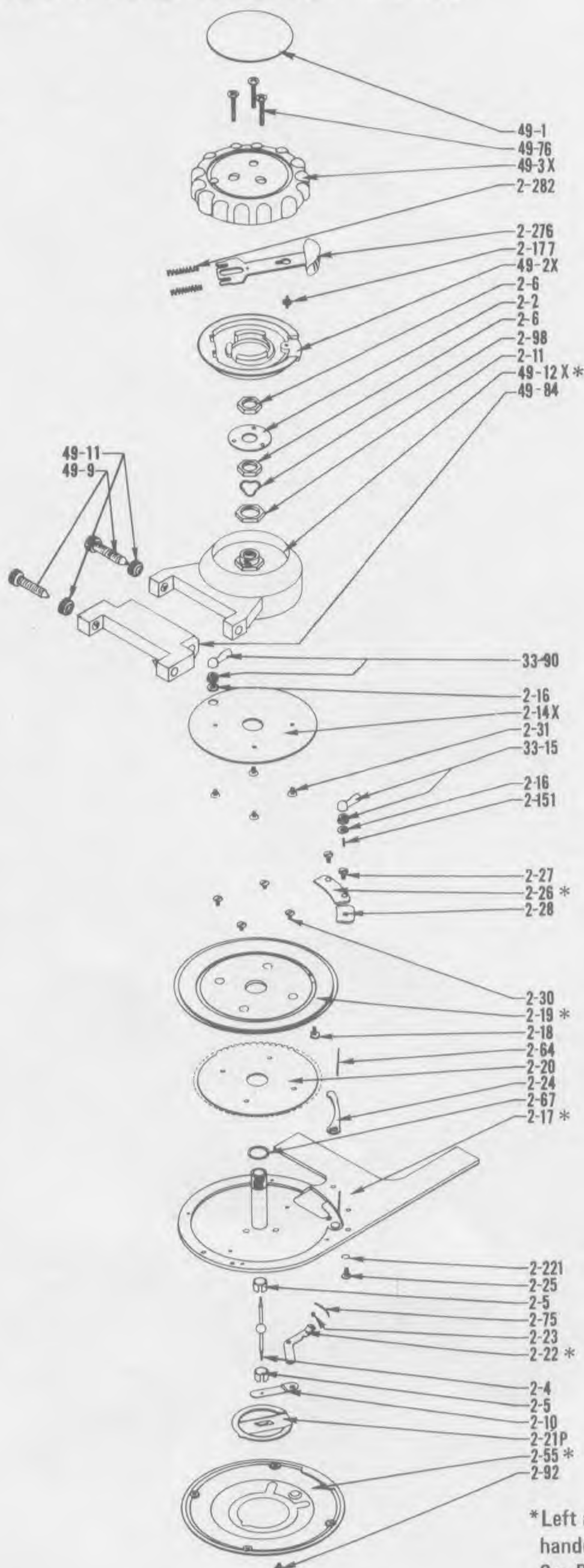
²Parts with numbers which include "X" (such as 50-10X) are improved versions of early parts for which the "X" was not included (such as 50-10) in the number.

³"LH" in a part number refers to the corresponding part for a left-handed machine.

VEMCO MODEL 2 V-TRACK DRAFTING MACHINE

MODEL 2 HEAD ASSEMBLY 49-101

49-101 HEAD ASSEMBLY \$70.00
(With Pivot Joint)



* Left and Right
handed parts.
See PARTS LIST.

PARTS LIST

PART NO. ¹	NAME	RETAIL PRICE
2-2	Handle Plate . . . . .	.90
2-4	Lock Pivot . . . . .	.85
2-5	Pivot Spacer . . . . .	.05
2-6	Half Nut . . . . .	.40
2-10	Link . . . . .	.15
2-11	Lock Nut . . . . .	.50
2-14X ²	Lock Plate	2.60
2-16	Wing Nut Washer . . . . .	.05
2-17	Base Plate & Spindle	14.95
2-17LH	Base Plate & Spindle LH	14.95
2-18	Lock Screw (T-Slot) . . . . .	.65
2-19	Standard Protractor	17.55
2-19LH	Standard Protractor LH	17.55
2-20	Index Plate	5.50
2-21P	Skid Button . . . . .	.85
2-22	Lock Lever . . . . .	.90
2-22LH	Lock Lever LH . . . . .	.90
2-23	Lock Roller . . . . .	.45
2-24	Index Pawl . . . . .	.60
2-25	Brake Screw . . . . .	.50
2-26	Vernier Plate	5.20
2-26LH	Vernier Plate LH	5.20
2-27	Vernier Screw . . . . .	.20
2-28	Protractor Brake	1.30
2-30	Index Plate Screw . . . . .	.20
2-31	Lock Plate Screw . . . . .	.20
2-55	Shield . . . . .	.85
2-55LH	Shield LH . . . . .	.85
2-64	Pawl Spring . . . . .	.05
2-67	Shim . . . . .	.05
2-75	Roller Spring . . . . .	.25
2-92	Shield Screw . . . . .	.05
2-98	Spring Washer . . . . .	.20
2-151	Wing Nut Spring . . . . .	.05
2-177	Release Pin . . . . .	.30
2-276 ⁵	Release (Indexing Thumb Piece)	1.80
2-282 ⁵	Lock Spring . . . . .	.05
2-221	Brake Screw Lock Washer . . . . .	.05
33-15	Wing Nut Handle w/33-16 Bushing	1.00
33-90	Base Line Wing Nut Handle w/33-16 Bushing	1.00
49-1	Handle Cover	1.00
49-2X	Lower Handle ³	1.45
49-3X	Upper Handle ³	1.60
49-9	Pivot Screw	1.30
49-11	Lock Nut	1.05
49-12X ²	Head Bracket ^{3,4} (including Spindle Bushing & 2-11 Lock Nut)	13.65
49-12XLH ²	Head Bracket ^{3,4} (including Spindle Bushing & 2-11 Lock Nut, LH)	13.65
49-76	Handle Screw . . . . .	.05
49-84	Pivot Joint ³	6.20
49-84A	Pivot Joint w/Pivot Screw ³	8.45
49-101-2 ⁴	Head Bracket & Lock Plate Sub-Assembly ^{3,4} (includes 49-12X, 2-14X, and four 2-31)	16.90

¹ "LH" in a part number refers to the corresponding part for a left-handed machine.

² The lock plate 2-14X and bracket 49-12X are installed in machines made after about Jan. 1, 1973. The earlier machines contain corresponding parts 2-14 and 49-12.

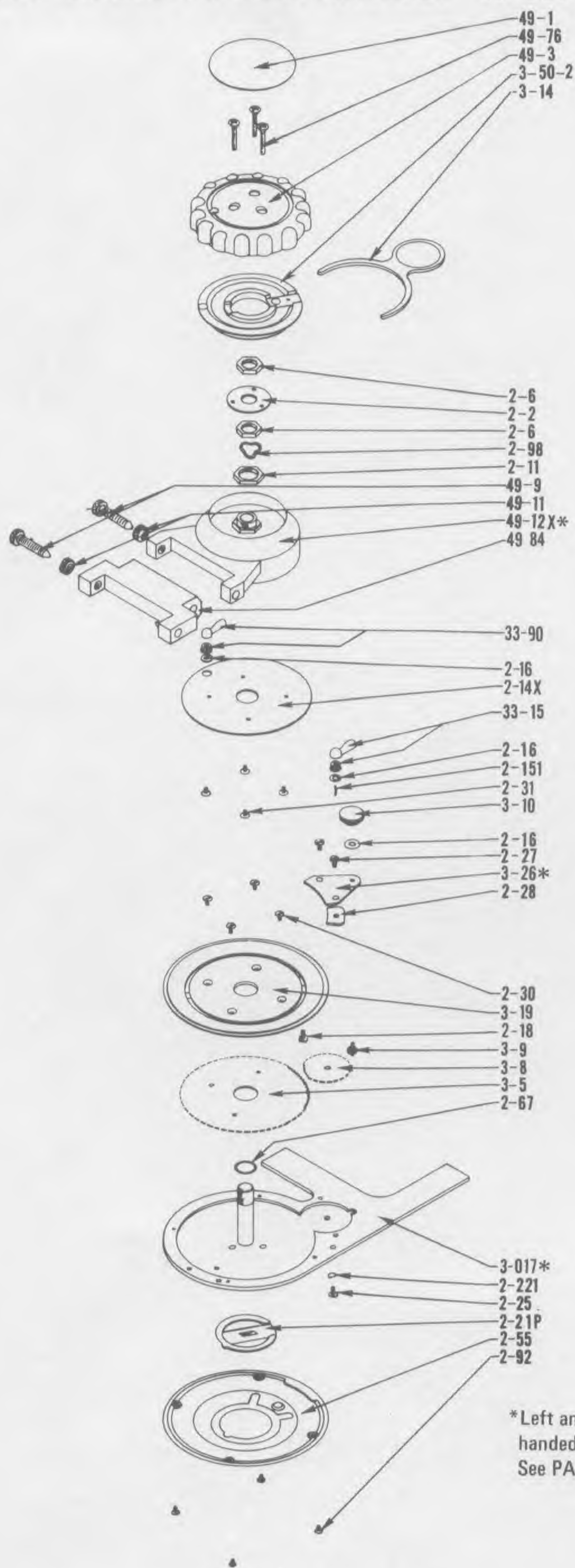
³ Specify color (black or gray) when ordering these plastic or painted parts.

⁴ To replace a spindle bushing or head bracket in a machine made before about Jan. 1, 1973, the 49-101-2 sub-assembly should be ordered and used to replace all of the corresponding parts in it.

⁵ Not present on machines with serial numbers less than Z156,000 (approximately). For these machines order 2-176 Release (\$1.80) and 2-182 Coil Lock Spring (\$.40).

VEMCO MODEL 3 V-TRACK DRAFTING MACHINE

CIVIL ENGINEER'S HEAD ASSEMBLY 49-301



*Left and Right handed parts. See PARTS LIST.

49-301 HEAD ASSEMBLY \$94.00
(With Pivot Joint)

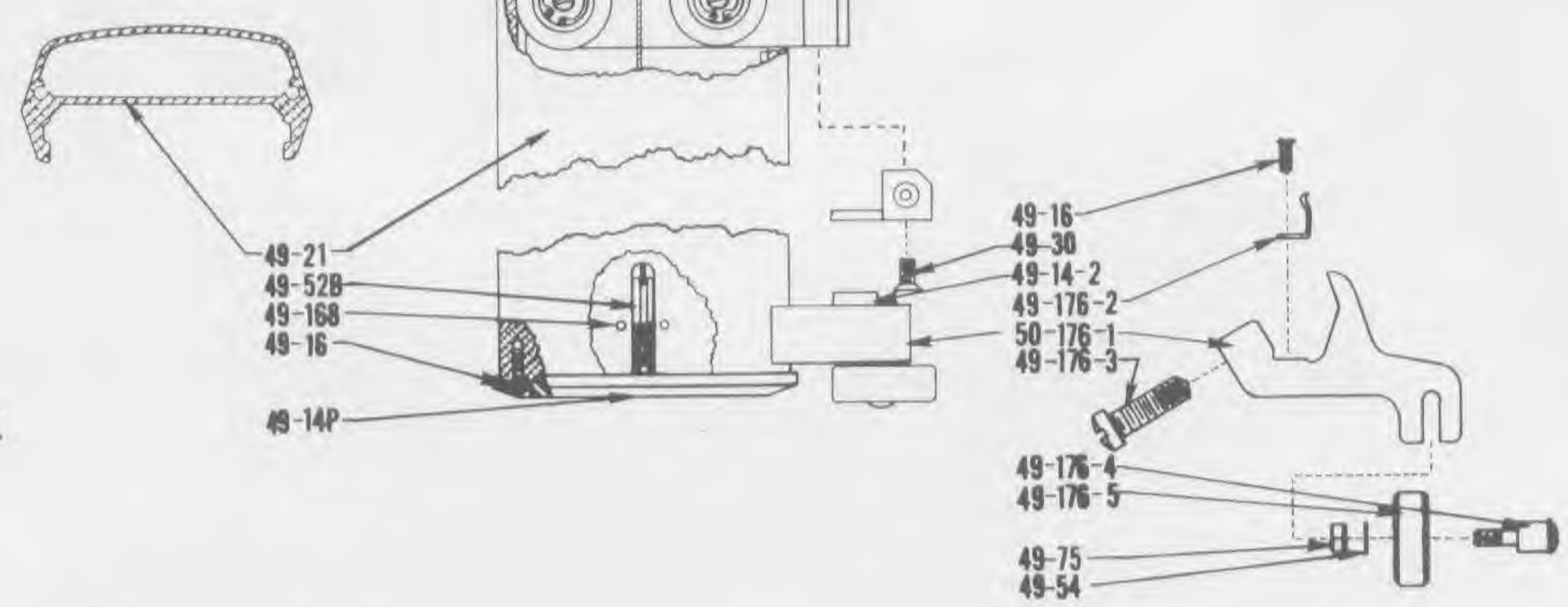
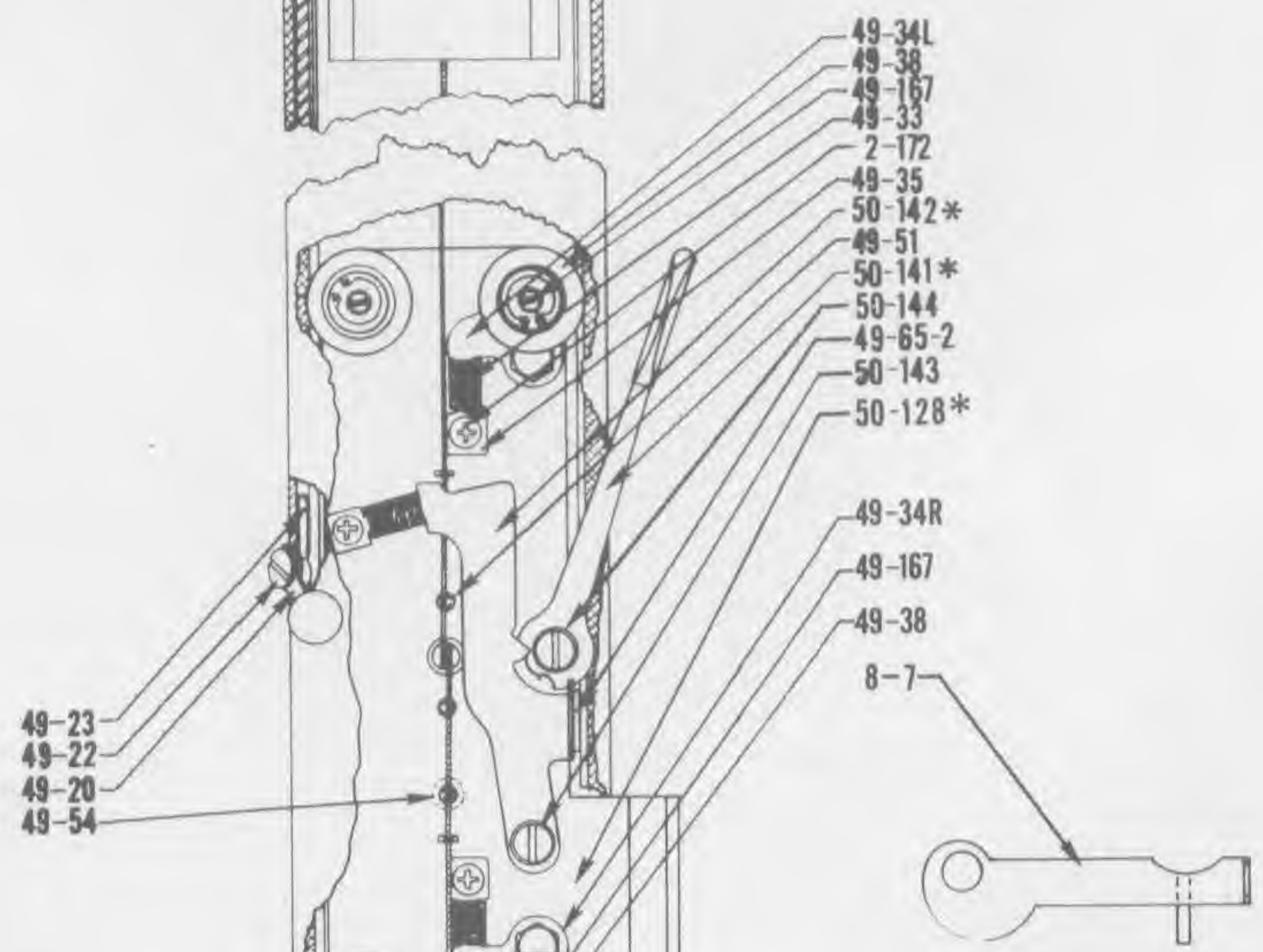
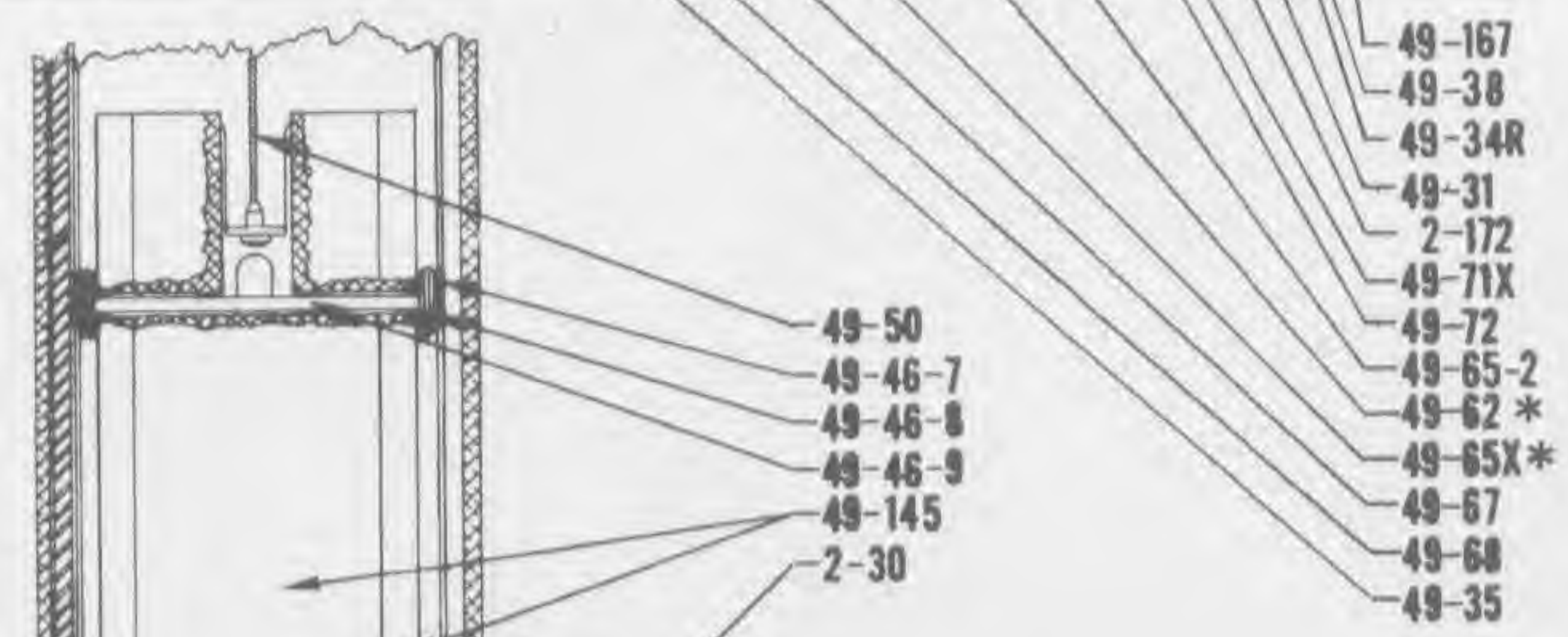
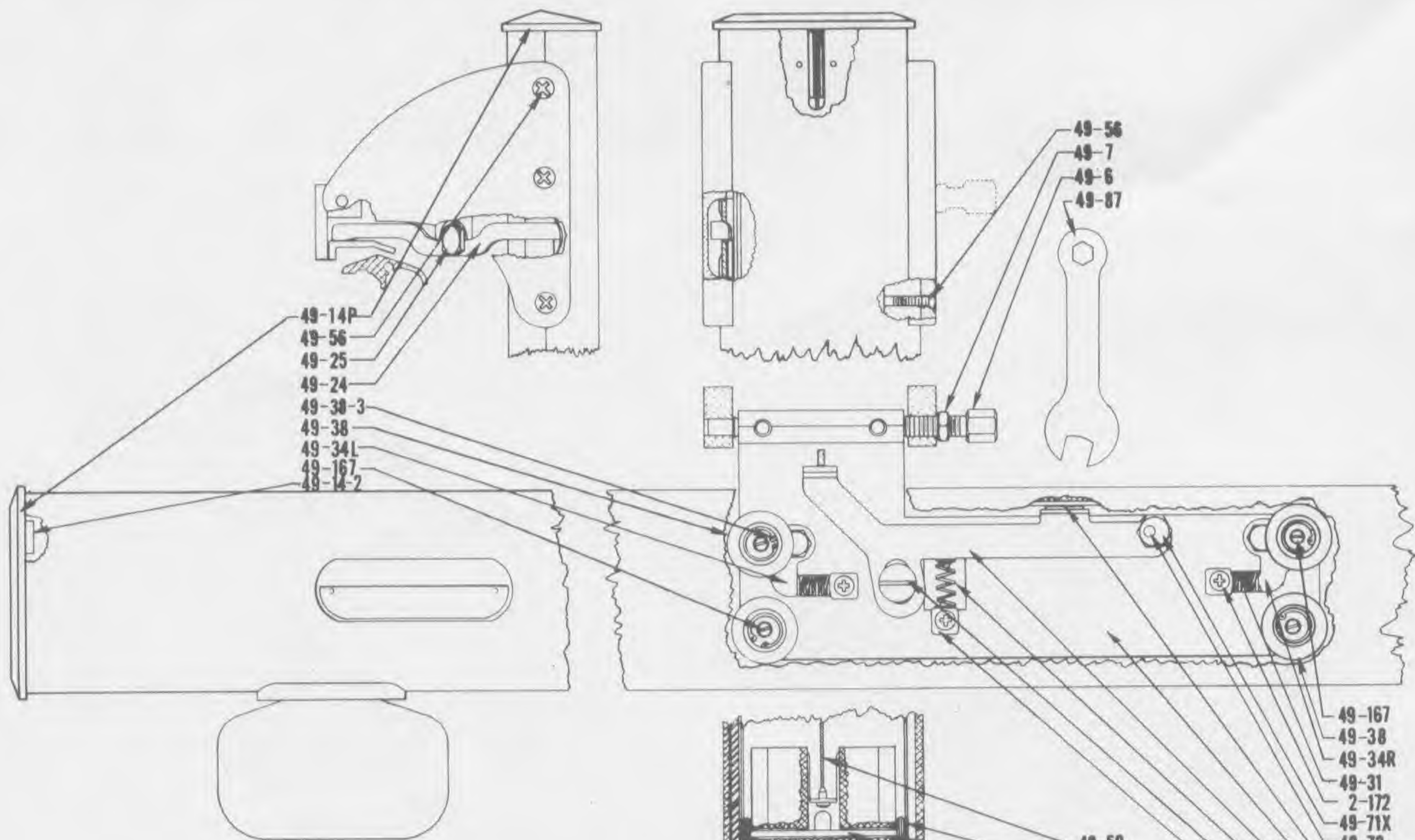
PART NO. ¹	NAME	RETAIL PRICE
2-2	Handle Plate .....	.90
2-6	Half Nut .....	.40
2-11	Lock Nut .....	.50
2-14X ²	Lock Plate	2.60
2-16	Lock Nut Washer .....	.05
2-18	Lock Screw (T-Slot) .....	.65
2-21P	Skid Button .....	.85
2-25	Brake Screw .....	.50
2-27	Vernier Screw .....	.20
2-28	Protractor Brake	1.30
2-30	Master Gear Screw .....	.20
2-31	Lock Plate Screw .....	.20
2-55	Shield .....	.85
2-67	Shim .....	.05
2-92	Shield Screw .....	.05
2-98	Spring Washer .....	.20
2-151	Wing Nut Spring .....	.05
2-221	Brake Screw Lock Washer .....	.05
3-5	Master Gear	1.95
3-8	Idle Gear	1.00
3-9	Set Pinion	1.60
3-10	Micrometer Knob	1.35
3-14	Magnifier	4.90
3-017	Base Plate & Spindle	13.40
3-017LH	Base Plate & Spindle LH	13.40
3-19	Protractor	25.35
3-19LH	Protractor LH	25.35
3-26	Vernier Plate	12.75
3-26LH	Vernier Plate LH	12.75
3-50-2	Lower Handle ³	1.80
33-15	Wing Nut Handle w/Bushing	1.00
33-90	Base Line Wing Nut Handle w/Bushing	1.00
49-1	Handle Cover	1.00
49-3	Upper Handle ³	1.60
49-9	Pivot Screw	1.30
49-11	Lock Nut	1.05
49-12X ²	Head Bracket ^{3,4} (including Spindle Bushing & 2-11 Lock Nut) ..	13.65
49-12XLH ²	Head Bracket ^{3,4} (including Spindle Bushing & 2-11 Lock Nut, LH)	13.65
49-76	Handle Screw .....	.05
49-84	Pivot Joint ³	6.20
49-84A	Pivot Joint w/Pivot Screw	8.45
49-101-2 ⁴	Head Bracket & Lock Plate Sub-Assembly ^{3,4} (includes 49-12X, 2-14X and four 2-31)	16.90

¹"LH" in a part number refers to the corresponding part for a left-handed machine.

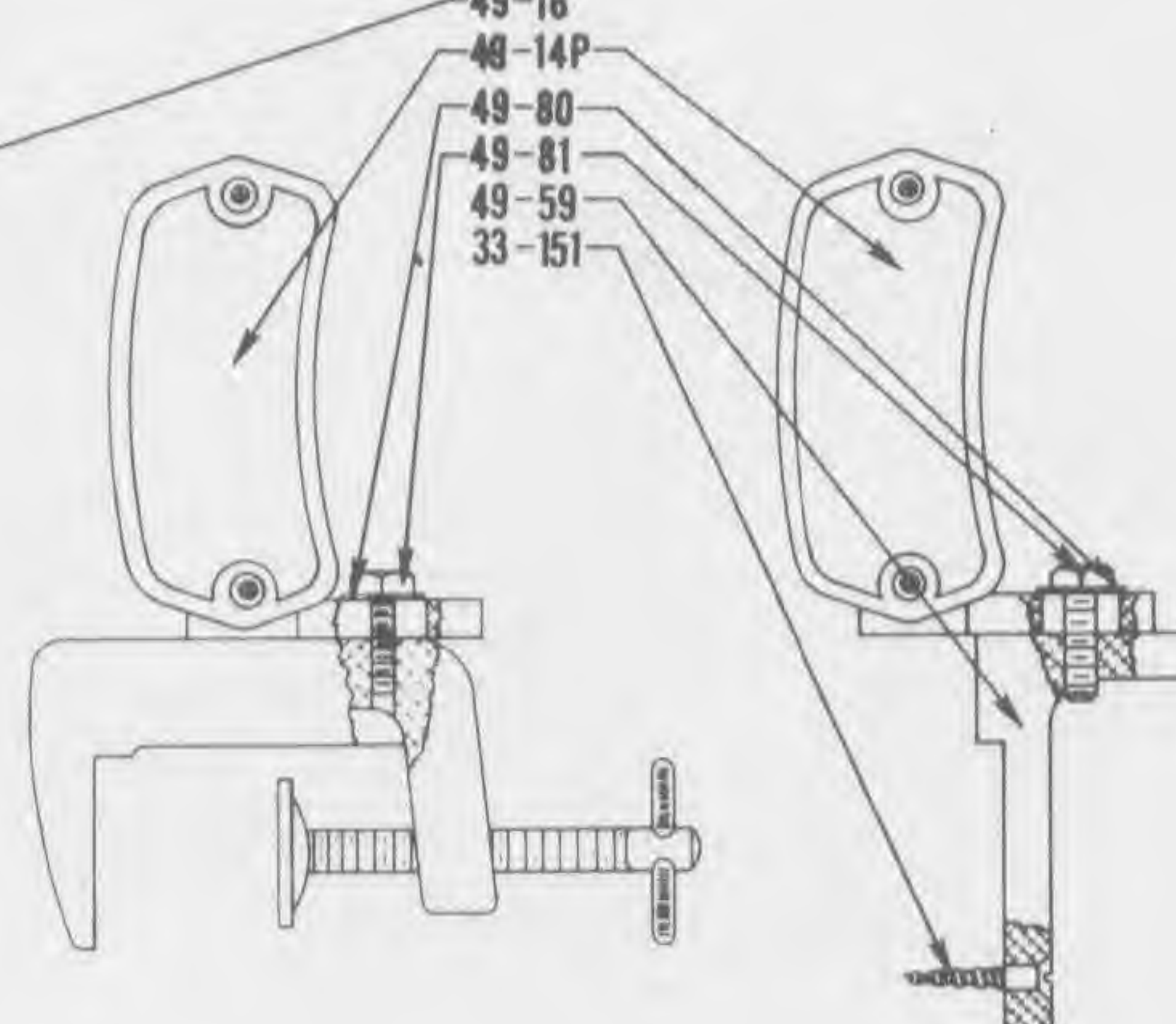
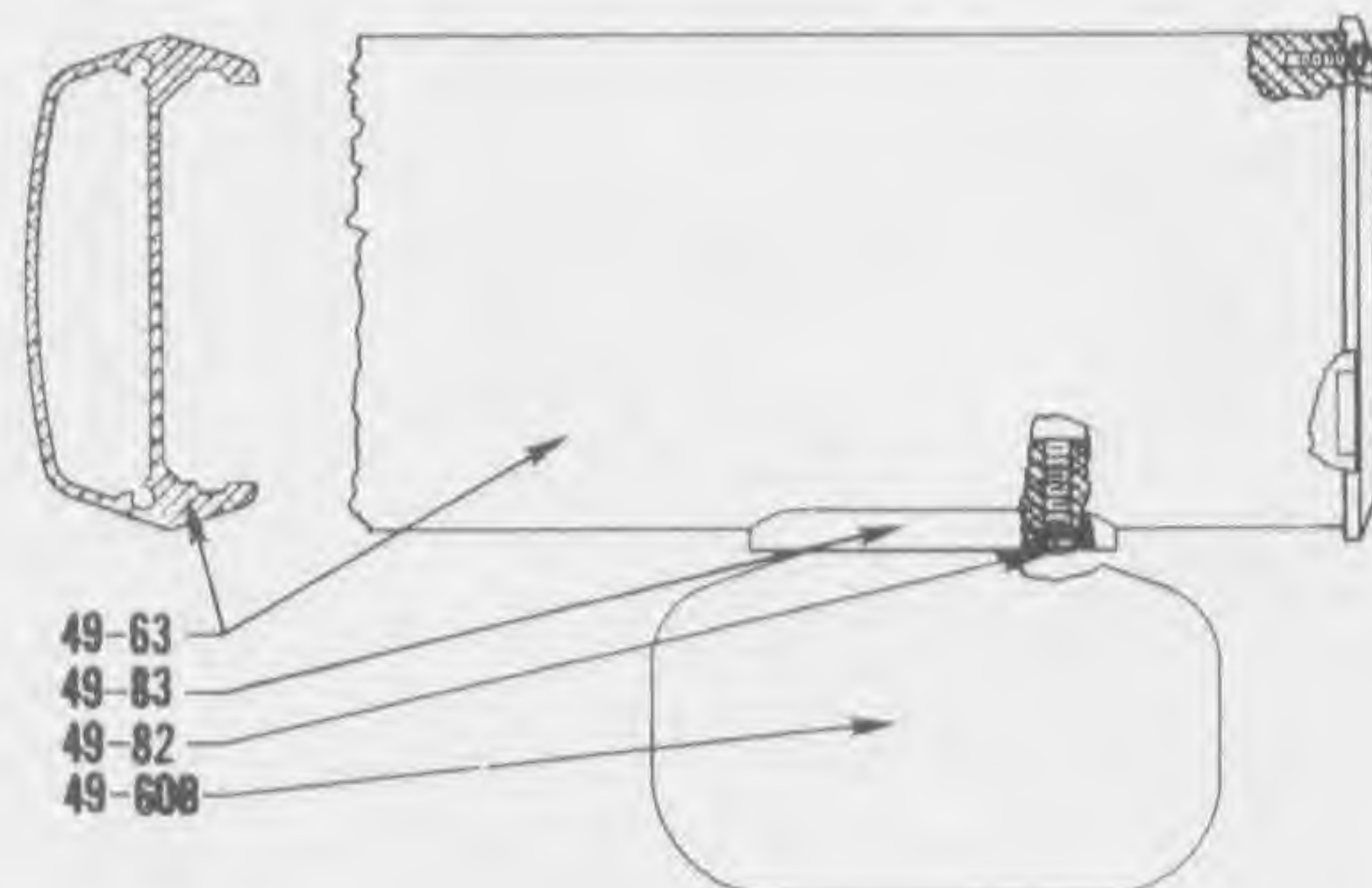
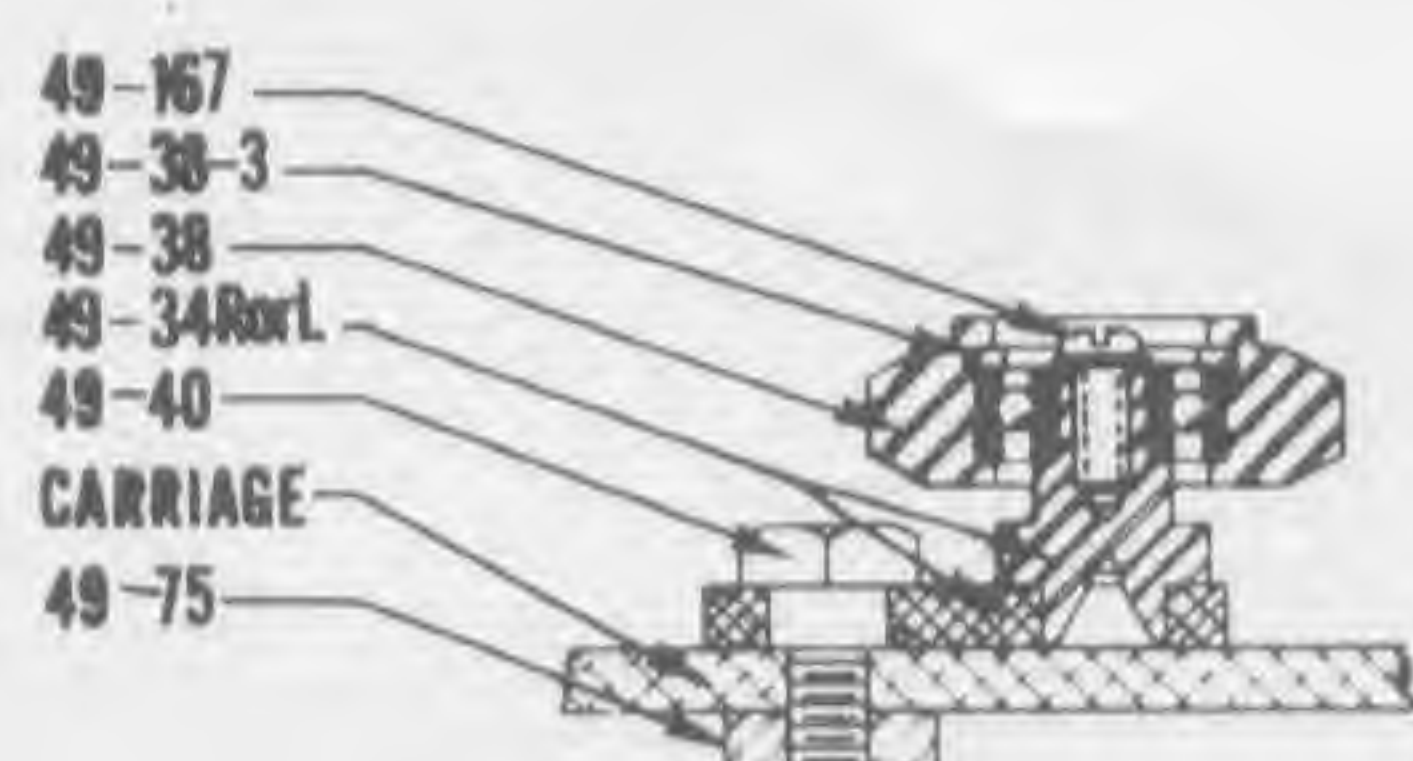
²The lock plate 2-14X and bracket 49-12X are installed in machines made after about Jan. 1, 1973. The earlier machines contain corresponding parts 2-14 and 49-12.

³Specify color (black or gray) when ordering these plastic or painted parts.

⁴To replace a spindle bushing or head bracket in a machine made before about Jan. 1, 1973, the 49-101-2 sub-assembly should be ordered and used to replace all of the corresponding parts in it.



*Left and right
handed parts.
See PARTS LIST.



VEMCO MARK XII DRAFTING MACHINES

PARTS LIST

Part No. ¹	Name	Retail Price	Part No. ¹	Name	Retail Price	Part No. ¹	Name	Retail Price
2-30	Index Plate Screw	.20	49-52B	Cable Pulley Assembly	3.90	50-128LH	Vertical Carriage Plate LH	9.75
2-172	Spring Housing Screw	.05	49-54	# 8 N.P. Brass Washer	.05	50-141	Vertical Brake Lever	1.95
8-7	Scale Wrench	.80	49-56	Vertical Track Bracket Screw	.05	50-141LH	Vertical Brake Lever LH	1.95
33-151	Wood Screw	.05	49-59B ³	Support Bracket	7.15	50-142	Vertical Brake	
49-6	Horizontal Pivot Screw	1.60	49-60B ³	Clamp Assembly	7.15		(incl. 49-65-2 Brake Lining)	1.15
49-7	Horizontal Lock Nut	.45	49-62	Horizontal Carriage Plate	9.75	50-142LH	Vertical Brake LH	
49-14	End Cover Assembly		49-62LH	Horizontal Carriage Plate LH	9.75		(incl. 49-65-2 Brake Lining)	1.15
	(including 49-14-2 Bumper)	.85	49-63 ²	Horizontal Track (incl. 49-14 End Covers and 49-83 Track Braces)		50-143	Vertical Brake Screw	.35
49-14-2	Bumper	.05		40-42"	43.00	50-144	Cup Washer	.05
49-16	4-40 x 5/16 PH End Cover Screw	.05		50"	48.00	50-156-1	Roller Leg	3.25
49-20	Horizontal Brake Lever	1.60		54"	51.00		ASSEMBLIES:	
49-21 ²	Vertical Track (incl. 49-14 End Covers)			60"	53.00	49-106A	Horizontal Carriage Assy	31.00
	30-32"	50.00		72"	58.00	49-106ALH	Horizontal Carriage Assy. LH	31.00
	36-37-1/2"	55.00		84"	68.00	50-102	Vertical Carriage Assy	34.00
	42-43-1/2"	65.00		96"	83.00	50-102LH	Vertical Carriage Assy. LH	34.00
	48"	75.00		120"	113.00	50-107A ²	Complete Vertical Track Assy.	
49-22	Cam Screw	.70					30-32"	103.00
49-23A	Actuating Rod		49-65X	Horizontal Brake Assembly			36-37-1/2"	108.00
	(for 30-32" Vertical Track)	3.10		(incl. 49-65-2 Brake Lining)	1.30		42-43-1/2"	118.00
49-23B	Actuating Rod		49-65XLH	Horizontal Brake Assembly LH			48"	128.00
	(for all Vertical Tracks except 30-32")	3.60		(incl. 49-65-2 Brake Lining)		50-107ALH ²	Complete Vertical Track Assy. LH	
49-24	Brake Connector	.25	49-65-2	Brake Lining	.05		(Same prices as right-handed parts)	
49-25	Brake Connector Screw	.45	49-67	Horizontal Brake Spring	.05	50-108A ²	Complete Horizontal Track Assy.	
49-30	Vertical Pivot Block Screw	.05	49-68	Horizontal Brake Screw	.35		40-42"	72.00
49-31	Horizontal Roller Spring	.05	49-71X	Eccentric Spacer	.45		50"	77.00
49-32X	Axle Washer	.05	49-72	Brake Bolt	.45		54"	80.00
49-33	Vertical Roller Spring	.05	49-75	Lock Nut 8/32 Std. Hex	.05		60"	82.00
49-34R	Floating Axle Assembly (R)	.65	49-80	Washer # 14 N.P. Brass	.05		72"	87.00
49-34L	Floating Axle Assembly (L)	.65	49-81	Brace Bolt 1/4-20 x 3/4	.05		84"	97.00
49-35	Spring Retainer	.05	49-82	Brace Screw	.05		96"	112.00
49-38	Roller Assembly		49-83 ³	Track Brace	1.30		120"	142.00
	(incl. 49-38-3 Snap Ring)	3.90	48-87	Wrench	.20	50-108ALH ²	Complete Horizontal Track Assy. LH	
49-38-3	Snap Ring	.05	49-89	Half Nut	.05		(Same prices as right-handed parts)	
49-39X	Off Center Axle	.90	49-145	Weight Carriage Assembly	10.40	50-176	Support Roller Assy.	5.85
49-40	Shoulder Screw	.40	49-167	4-40 x 1/4" Roller Screw	.05			
49-46-7	# 1200-9 E-Ring	.05	49-168	4-40 x 1/4" Cable Pulley Screw	.05			
49-46-8	Balance Roller	.25	49-176-2	Roller Leg Lock	.20			
49-46-9	Balance Axle	.40	49-176-3	Roller Leg Lock Screw	.05			
49-50	Cable	1.95	49-176-4	Roller Screw	.60			
49-51	Cable Screw	.05	49-176-5	Support Roller	.65			
			50-128	Vertical Carriage Plate	9.75			

¹"LH in a part number refers to the corresponding part for a left-handed machine.

²Specify finish — T (teak), W (walnut), or B (black); includes bracket for attachment to horizontal carriage.

³Specify color when ordering.

OTHER VEMCO PRODUCTS

DRAFTING MACHINE SCALES

Graduations (all full divided)	Transparent Plastic	Aluminum
Full and half size	9-P-1*	9-S-1*
Full, half and quarter size	9-P-2*	9-S-2*
1 1/2", 3" to 1'	9-P-3	9-S-3
3/8", 3/4" to 1'	9-P-4	9-S-4
1/2", 1" to 1'	9-P-5	9-S-5
1/8", 1/4" to 1'	9-P-6	9-S-6
10ths and 50ths of inches	9-P-7*	9-S-7*
20ths and 40ths of inches	9-P-8*	9-S-8*
30ths and 60ths of inches	9-P-9*	9-S-9*
Metric, 1 mm. and 1/2 mm.	9-P-10	9-S-10
1/8"-1/4", 1/2"-1" to 1'	9-P-11*	9-S-11*
3/8"-3/4", 1 1/2"-3" to 1'	9-P-12*	9-S-12*
40ths and 50ths of inches	—	9-S-13
Straightedges 9", 12" and 18" (24" available in Aluminum only)	9-P-14*	9-S-14*
32nds and 50ths of inches	9-P-15*	9-S-15*
32nds and 50th of inches, full and 1/2 size	9-P-15B	9-S-15B
Quarter and eighth size	9-P-20	9-S-20
1/4 and 1/2 size to 40ths and 1/10 and full size to 50ths; quick reading	9-P-21	9-S-21
1/4 and 1/2 size to 40ths, regular graduations, and 1/10 and full size to 50ths; quick reading	9-P-22	9-S-22
Metric, 1mm and 50ths of inches	9-P-25	
Metric, 1mm and 32nds of inches	9-P-26	

IMPORTANT ORDERING INSTRUCTIONS

1. Specify length of scale — 9", 12" or 18".
2. Order by catalog number to indicate type of graduations required.
3. Specify whether aluminum or transparent plastic is desired.
4. Plastic or aluminum scales of the same size are priced alike.

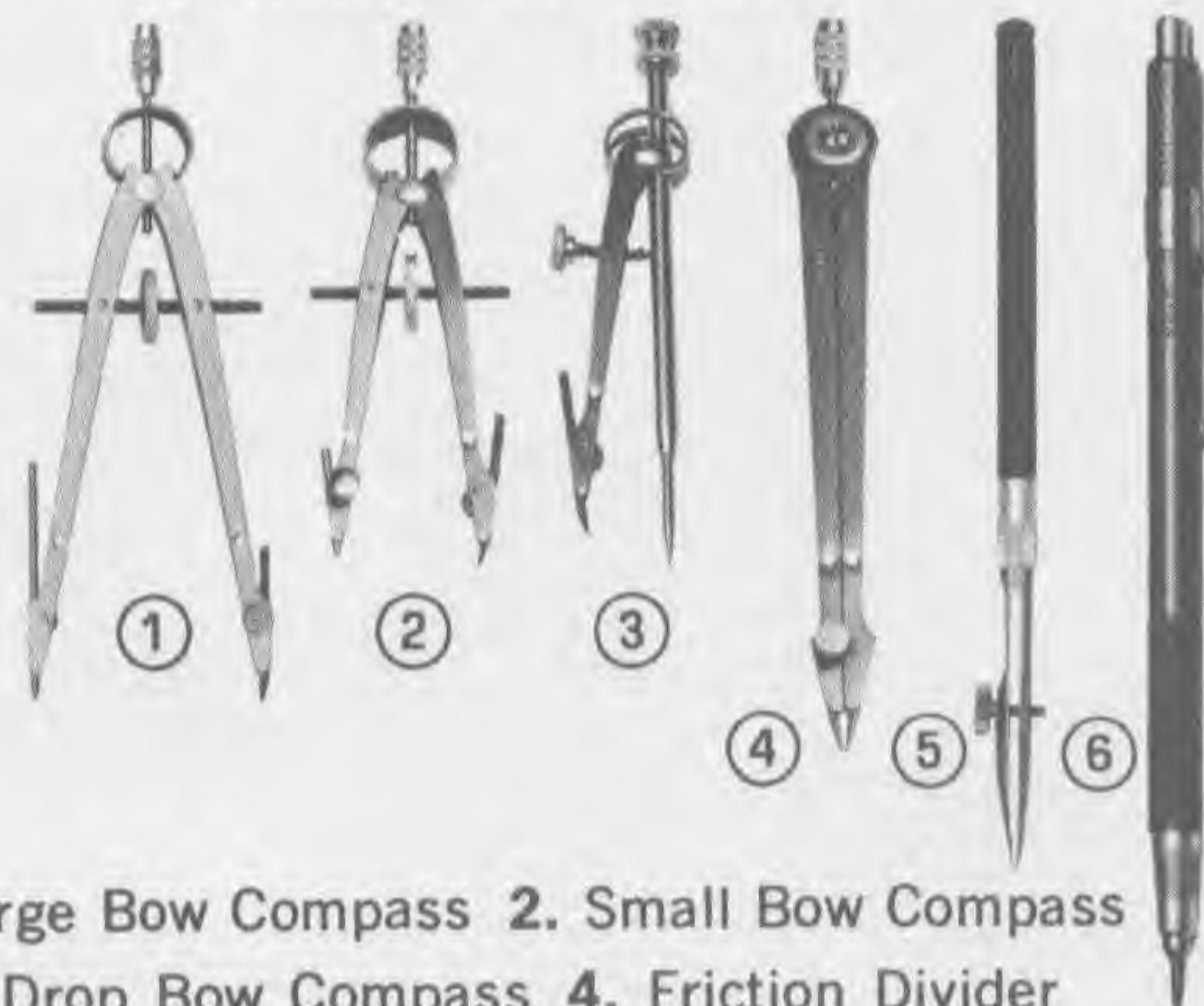
*Also available in 9" lengths.

All inch and foot scales available in 12" and 18" lengths.

9" scales available in scales indicated on chart.

Metric scales available in 300mm and 450mm lengths.

DRAWING INSTRUMENTS



1. Large Bow Compass 2. Small Bow Compass
3. Drop Bow Compass 4. Friction Divider
5. Ruling Pen 6. Leadmaster Lead Holder



7. Beam Compass 8. Beam Extension and Coupler
9. Beam Attachment 10. Pen Attachment
11. Detachable Pen Handle 12. Eraser Holder
13. VEMCO Drawing Leads
14. Technical Pen Adaptors

A VARIETY OF INSTRUMENT SETS AVAILABLE
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